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PALEONTOLOGY.—*Some notes on the Pentameracea, including a description of one new genus and one new subfamily.*

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The writer has recently been engaged in a study of the brachiopods belonging to the superfamily Pentameracea in preparation for the forthcoming *Treatise on invertebrate paleontology*. An investigation of the literature has shown that a new name is needed for the type species of *Gypidula* and that *Barrandella* Hall and Clarke is an objective synonym of *Antirhynchonella* Oehlert. In addition, a study of the collections at the U. S. National Museum has made it possible to add some further information on a previously described genus, *Platymerella* Foerste, and a previously described species, *Pentamerella areyi* (Hall and Clarke). A new genus, *Costistricklandia*, and a new subfamily, Pentameroidinae, are proposed in this report, and a brief discussion of the pentameroid classification, including a list of known genera, is given.

The writer is indebted to Dr. G. A. Cooper for permitting an examination of the collections of the U. S. National Museum and also for valuable suggestions and criticisms during the preparation of this manuscript.

There has been general unanimity of opinion among the different investigators of the Pentameracea on the importance of the brachial structures in the taxonomy of the group, but there has not been complete agreement on the names to be applied to such structures. The morphologic terms employed in this report (Fig. 1) are essentially the same as those used by Schuchert and Cooper in 1932. In their text figures 26–28 these authors illustrate two distinct types of structure in the brachial valve. One type, which is found in such genera as *Conchidium* and *Pentamerus*, shows each of the brachial plates to be tripartite, consisting of inner plates, brachial process, and outer plates with the last resting directly upon the floor of the valve; the second type, shown in the genus *Pentameroides*, is quadripartite, with each brachial plate composed of inner plate, brachial process, outer plate, and median septum. The writer believes that this terminology accurately describes the brachial structures of the Pentameracea with one exception: namely, the median septum of *Pentameroides* is thought to consist of two plates for which the name septal plates is employed (see discussion of Pentameroidinae).

Schuchert and Cooper applied these names consistently in their systematic descriptions of the various pentameroid genera. However, in their general discussion on the morphology of the Pentameracea (pp. 164–165) they did not use precisely this system but used a modification of Leidhold (1928, pp. 51–53). They state:

> The cardinalia of the Pentameridae are the most characteristic feature of the genera and probably of the family as well. These lamellae are divisible into four distinct units termed by Leidhold: (1) The inner crural plate, (2) the outer crural plate, (3) the crural band or border, (4) the septal plate. We prefer to term the first two of these parts simply the outer and inner plates, since we do not feel that it is at present certain that they are the homologues of the crura such as occur in the Rhynchonellacea and Terebratulacea.

For convenience in comparison, two illustrations of Leidhold are reproduced in Fig. 2.

This terminology of Leidhold does not appear to be entirely satisfactory. Although the writer has never examined a specimen of *Gypidula brevirostris*, it would appear

from Leidhold's figure that the "Äussere Cruralplatte" and the "Cruralleiste" represent merely the posterior portion of the brachial process which in this genus is broad and bladelike (see Fig. 1, A). Furthermore, this author used a somewhat different system in describing the genus *Enantiosphen* (1928, pl. 5, fig. 3). The word "Cruralleiste" was dropped entirely, and "crus" was employed for the structure separating the "Innere Cruralplatte" and platte" and "Äussere Cruralplatte" (and extending on beyond these two plates). This usage fits in better with the known structure of the pentameroid brachiopods although the writer concurs with Schuchert and Cooper in their desire to drop the word crura in connection with the Pentameracea. It should be noted that the genus *Enantiosphen* is an unusual pentameroid brachiopod in that the brachial processes terminate in a loop, but at the posterior end the brachial plates which support these processes are pentameroid in their structure and are thought by the writer to exhibit some similarities with the genus *Penta-*

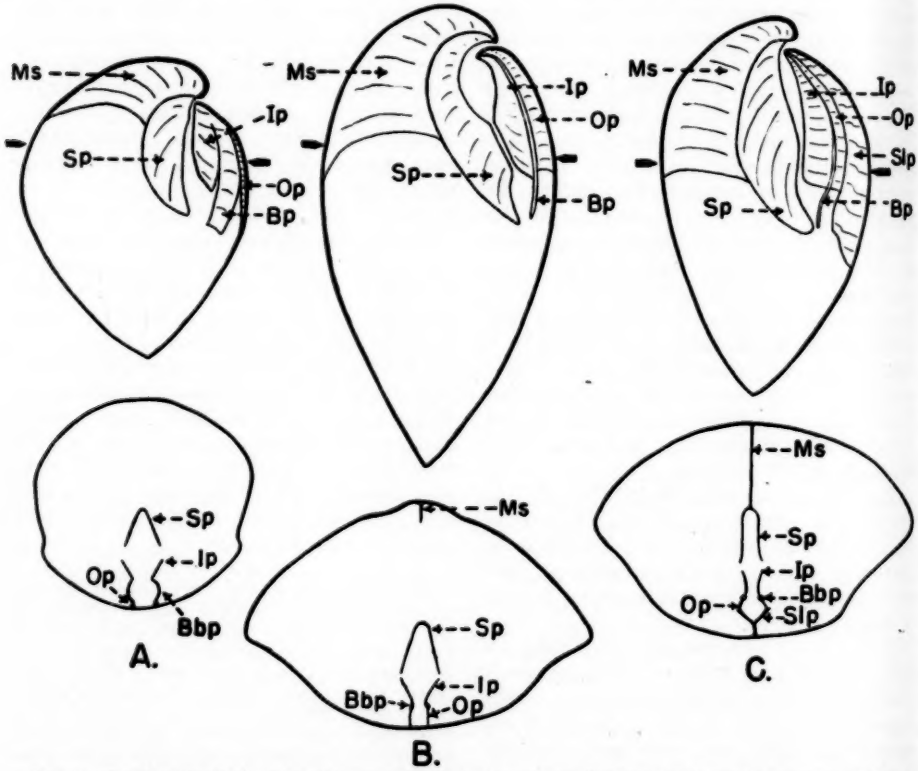

FIG. 1.—Longitudinal (above) and transverse (below) sections showing the internal structure of three subfamilies of the Pentameridae. Heavy, unlettered arrows on longitudinal sections indicate the position of the transverse sections. Transverse sections with pedicle valve above.

A. GYPIDULINAE. *Gypidula coeymanensis prognostica* Maynard. Silurian (Keyser), Keyser, W. Va.

B. PENTAMERINAE. *Pentamerus* cf. *P. oblongus* Sowerby. Silurian (Clinton), New York.

C. PENTAMEROIDINAE. *Pentameroides subrectus* (Hall and Clarke). Silurian (Niagaran), Jones County, Iowa.

Ms—Median septum
Sp—Spondylium
Ip—Inner plate
Bp—Brachial process
Bbp—Base of brachial process
Op—Outer plate
Slp—Septal plate

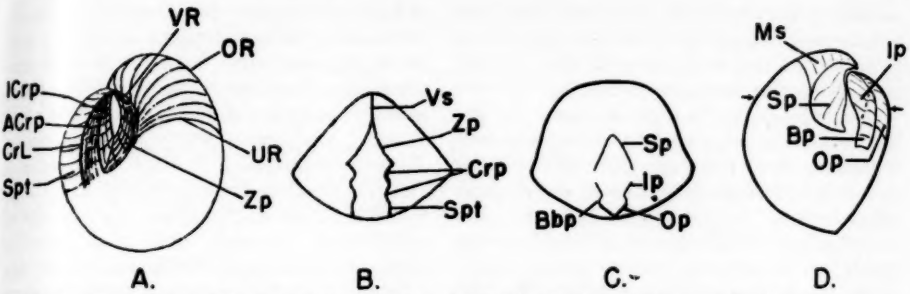

FIG. 2.—Comparison of the terminology used by Leidhold with that of the present paper:
A. Longitudinal section of *Gypidula brevi rostris* Phill. After Leidhold. VR—Vorderrand des ventralen Medianseptums; OR—Oberrand des ventralen Medianseptums; UR—Unterrand des ventralen Medianseptums; ZP—Zahnplatten, das Spondylium bildend; ICrp—Innere Cruralplatte [inner plate]; Acrp—Äussere Cruralplatte [base of brachial process]; Crl—Cruralleiste [junction of brachial process and outer plate]; Spt—Septalplatte [outer plate].
B. Transverse section of *"Pentamerella" sublinguifer* Maur. [*Clorinda? sublinguifer*]. After Leidhold. Vs—Ventrales Medianseptum [median septum]; Zp—Zahnplatten, das Spondylium bildend [spondylium]; Crp—Cruralplatten [inner plate plus base of brachial process]; Spt—Septalplatten [outer plate].
C and D. Transverse and longitudinal sections of *Sieberella roemeri* Hall and Clarke. Silurian (Brownsport), western Tennessee. Arrows on longitudinal section indicate position of transverse section; transverse section with pedicle valve above. Sp—spondylium; Ms—median septum; Ip—inner plate; Op—outer plate; Bp—brachial process; Bbp—base of brachial process.

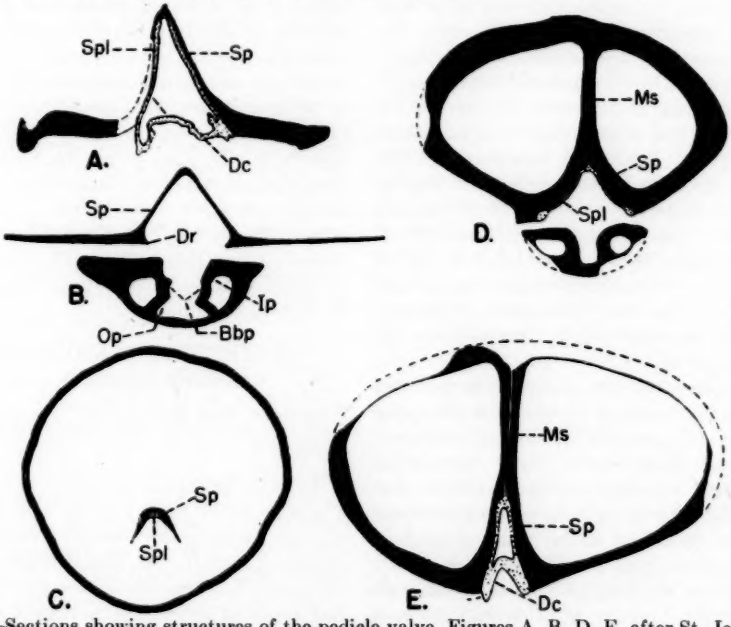

FIG. 3.—Sections showing structures of the pedicle valve. Figures A, B, D, E, after St. Joseph.
A. *Aliconchidium yassi* St. Joseph. Silurian (Hume series), New South Wales.
B. *Clorinda undata* (Sowerby). Silurian, Norway.
C. *Virgiana barrandei* (Billings). Silurian (Becsie River), Anticosti Island.
D. *Pentamerus borealis* (Eichwald). Silurian, Norway.
E. *Pentamerus* [?] cf. *P. gotlandicus* Lebedev. Silurian, Norway.

Bbp—Base brachial process
Dc—Deltidial cover
Dr—Delthyrial ridge
Ip—Inner plate
Ms—Median septum
Op—Outer plate
Sp—Spondylium
Spl—Spondylial lining

meroides. It seems desirable to keep the terminology applied to these two genera as nearly as possible in accord with that applied to other genera in this superfamily.

Accordingly the writer proposes to use the names as employed by Schuchert and Cooper in their text figures 26–28 (with the exception noted above) as being the method which most satisfactorily describes the morphology of this group; it also has the merit of being the system most widely accepted by writers since 1932. (See St. Joseph 1937, pp. 231–254).

The major structure of the pedicle valve is the spondylium which has been rather universally termed a spondylium duplex because of its two fold character. This spondylium duplex may be lined on the inside with a layer of shell material which is different in appearance from the outer wall (Fig. 3). St. Joseph (1937, pp. 240–248) has given a good description of this, finding it to be present in certain species of *Pentamerus, Conchidium, Stricklandia* and *Aliconchidium*. This spondylial lining varies in its thickness and in some specimens may extend downwards for some distance as a thin selvage which separates the two layers of the septum (Fig. 3, E). Kozlowski (1929, pp. 124–125, fig. 37) described a similar selvage of material in *Sieberella* cf. *galeata* and applied the name "lame intraseptale." The writer has seen a spondylial lining in specimens of *Costistricklandia gaspeensis* (Billings), *Virgiana barrandei* (Billings), *Brooksina alaskensis* Kirk, *Stricklandia* sp. and *Conchidium* sp.

St. Joseph (1937, pp. 231–240) noted that in certain specimens of *Pentamerus* the upper edge of this spondylial lining extended across the delthyrium, thus completely closing that opening at the posterior end (Fig. 3, E). This he called a pseudodeltidium and later found it to be also present in *Aliconchidium yassi* St. Joseph (Fig. 3, A).

Kozlowski (1929, p. 130) has also observed that certain species of *Conchidium* and *Pentamerus* may have the delthyrium completely closed by a plate, but he called this a syndeltarium and thought it was formed by the fusion of two plates. Schuchert and Cooper (1932, p. 163) recorded a somewhat similar covering in *Conchidium* and *Harpidium* which they preferred to designate by the noncommittal term, deltidial cover. At the present time it is not known how common a structure this is in the Pentameracea. It is apparently always very thin and delicate, and consequently could be easily destroyed; therefore, it may be more universally developed than present knowledge would indicate. Furthermore, the taxonomic significance of such delthyrial covering plates is uncertain at the present time and it would therefore seem advisable to use a noncommittal name such as deltidial cover rather than an expression which implies a homology with a structure in some other group of brachiopods.

There are some pentameroids in which the inner margins of the delthyrium show a thickening or callosity (Fig. 3, B). The significance attached to such structures has varied with different authors, just as it has with the deltidial covers. Hall and Clarke called them deltidial plates and used them to some extent in generic diagnosis whereas Kozlowski (1929, p. 130) applied the name deltarium discretum and considered them to be of ordinal rank. Schuchert and Cooper (1932, p. 163), on the other hand, did not attach much significance to them, noting that they do not close the delthyrium to any notable degree. Structures of this kind which the writer has observed seem to be primarily for the purpose of strengthening the shell margin rather than restricting the delthyrial opening.

SYSTEMATIC PALEONTOLOGY

Gypidula typicalis, n. name

Pentamerus occidentalis Hall, 1858, p. 514, pl. 6, fig. 2; non *Pentamerus occidentalis* Hall, 1852, p. 314.

The genolectotype (Oehlert, 1887, p. 1311) of *Gypidula* is *Pentamerus occidentalis* Hall, 1858, a name that is preoccupied by *Pentamerus occidentalis* (*Conchidium occidentale*) Hall, 1852. This homonym has been recognized for many years, but many of the earlier workers thought that *Pentamerus occidentalis* Hall, 1858, equaled *Atrypa comis* (*Gypidula comis*) Owen, 1852. Belanski (1928, pp. 8–9, pl. 2, figs. 1–8), who gave a good description and illustration of Hall's species, noted that there were valid specific differences between Owen's species and that of Hall

but failed to give a new name to the latter. Therefore, it is here proposed that *Gypidula occidentalis* (*Pentamerus occidentalis* Hall, 1858, p. 514, pl. 6, fig. 2; non *Pentamerus occidentalis* Hall, 1852, p. 314) be named *Gypidula typicalis*.

Genus **Antirhynchonella** Oehlert, 1887

Antirhynchonella Oehlert, 1887 (*in* Fischer's Manuel de Conchyliologie, fasc. XI: 1311; non Quenstedt, 1871, pp. 231, 727).

Synonym: *Barrandella* Hall and Clarke, 1893 (pp. 241, 245).

Genotype: *Atrypa linguifera* Sowerby, 1839 (*in* Murchison's Silurian System, p. 629, pl. 13, fig. 8).

The status of the generic name *Antirhynchonella* has been in doubt for a number of years, although it has generally been credited to Quenstedt (type species, *tenuistriatus* Walmstedt) and suppressed as a synonym of *Conchidium*. The name was first used by Quenstedt (1871, p. 231) in the following manner:

> Aechte Pentameren haben entweder an der Stirn correspondirende Valven, oder Sinus und Wulst ist entgegengesetzt den Rhynchonellen, gleichsam Antirhynchonellen. Selbst die faustgrosse eiförmige tenuistriatus Walmst. auf Gothland, vom Habitus des glatten Esthonus (Eichwald Lethaea ross. I pag. 789) bewahrt diesen markirten Unterschied. Dagegen zeichnen die Engländer einen kleinen glatten Pentamerus linguifer Murch. Siluria 22.21 aus, der seine Zunge entgegengesetzt zur Bauchschale hinauf wendet.

In the index for this publication the name appears as *Antirhynchonella*, but it is not mentioned in the summary of genera and subgenera.

The next usage of the name is by Oehlert (1887, p. 1311), where it is given as *Antirhynchonella* Quenstedt; it appears as a "section" under *Conchidium* and is clearly used as a generic name. A diagnosis is given and the type is designated as *Atrypa linguifera* Murchison (both Quenstedt and Oehlert incorrectly give the author of *linguifera* as Murchison; it should be Sowerby in Murchison, Silurian System, p. 629, pl. 13, fig. 8).

Hall and Clarke (1894, footnote, p. 245) appear to have been in some doubt as to whether Quenstedt had used the name in a generic sense, pointing out that in the text he employed the name as simply the "Antirhynchonellas" and that it was only in the index that the latin form was applied. Although they were uncertain on this point, they apparently decided to accept it as a valid name but objected to Oehlert's type designation because, they state: "If any species can be taken as typical of ANTIRHYNCHONELLA, it is *Conchidium tenuistriatus*, Walmstedt, mentioned in immediate connection with the single use of this name, and not *Pentamerus linguifer* [a], which is cited by Quenstedt as an illustration of the fact that the position of the fold and sinus in the pentameroids is sometimes the same as in the Rhynchonellas." Hall and Clarke thought that the species *tenuistriatus* Walmstedt should be referred to the genus *Conchidium* and proposed to erect a new genus *Barrandella* for those pentameroid brachiopods having the structure of *linguifera* Sowerby.

Most later workers have followed Hall and Clarke in this interpretation, regarding *Barrandella* as a valid genus (*linguifera* as the type) and suppressing *Antirhynchonella* (*tenuistriatus* as type) as a synonym of *Conchidium* (Schuchert and Cooper, 1932, pp. 173, 181)

It appears to the present writer, however, that the manner in which the latin form *Antirhynchonella* was published in the index to Quenstedt's book cannot be regarded as acceptable.[1] In the first place there is no evidence that Quenstedt himself was responsible for the appearance of this name in the index to his book, it being just as probable that this entry in the index was due to a misreading of the text passage (p. 231) by another person who compiled the index. Second, even if Quenstedt himself compiled the index and was thus responsible for the appearance of the name *Antirhynchonella* on page 727, such a method of publication can not properly be held to have provided the name with an "indication" for the purpose of Article 25 (Proviso [a]) of the Rules. The name *Antirhynchonella* does not appear on the page cited in the index, the only reference on that page which can be held to have any connection with this subject is the vernacular word "Antirhynchonellen." But as long ago as 1907 the International Commission on Zoological Nomenclature ruled (Opinion 1) that a vernacular name is not to be accepted as an "indication." Therefore, the conclusion must be that even if Quenstedt did publish the generic name *Antirhynchonella* in his index it should be regarded as a nomen nudum.

Under these circumstances the name *Antirhynchonella* dates from Oehlert, 1887, with the type species *Atrypa linguifera* Sowerby, 1839, by

[1] The writer is indebted to Francis Hemming, secretary of the International Commission on Zoological Nomenclature, for giving much information and help on this taxonomic problem.

original designation; accordingly *Barrandella* Hall and Clarke, 1894, becomes an objective synonym. It does not appear to the writer that the suppression of the name *Barrandella* will cause any great amount of confusion since the genus is not especially common nor does it affect any names above generic rank.

The writer has submitted the foregoing information to the International Commission on Zoological Nomenclature with a request that *Antirhynchonella* Quenstedt, 1871, be placed on the *Official index of rejected and invalid generic names in zoology* and that *Antirhynchonella* Oehlert, 1887, be placed on the *Official list of generic names in zoology*.

Platymerella manniensis Foerste

Fig. 4

Platymerella manniensis Foerste, 1909, pp. 70–71, pl. 1, figs. 1A–D; non *Platymerella manniensis* Foerste, 1920, pp. 223–224, pl. 23, figs. 5, A–H).

The genus *Platymerella* was proposed by Foerste in 1909, its description being based upon the single species *P. manniensis* from Silurian strata (Brassfield) at Riverside near Mannie, Tenn. It was distinguished largely upon such external characters as absence of a straight hinge margin, small, subequal beaks and nongaleatiform profile. Foerste noted that the pedicle valve had a short spondylium and septum but did not otherwise describe the internal structure. A few years later Foerste (1920, pp. 223–224), obtained some specimens from the Brassfield at Lawshe, Adams County, Ohio, which he considered conspecific with those from Tennessee. This material included some free interiors of both valves and on this evidence he enlarged his earlier definition and suggested that *Platymerella* was most closely related to *Pentamerella*. Foerste's illustrations of the brachial interiors of these Ohio specimens show two distinct types of structure: one shows parallel brachial plates (pl. 23, fig. 5H and ?5G) as in *Gypidula* whereas the other (pl. 23, fig. 5E, 5F) shows a small cruralium. In 1932 Schuchert and Cooper (pp. 184–185) reviewed this genus and referred it to the Pentamerinae rather than the Gypidulinae. They also noted this discrepancy in the nature of the brachial interior and suggested that Foerste may have illustrated specimens belonging to two different genera.

Dr. G. A. Cooper, of the U. S. National Museum, very kindly furnished the writer with a specimen of *P. manniensis* from the type locality at Mannie, Tenn., which was serially sectioned to show the internal characters. As is shown in Fig. 4, the brachial plates are extremely short with the inner plates extending forward about 3.5 mm and the brachial processes continuing on beyond this as slender, rodlike structures. It is not possible from the material at hand to tell whether the brachial processes are supported at their posterior end by outer plates or whether they attach directly to the valve. If outer plates are present, they are extremely short and are confined to the posterior tip of the shell. The pedicle valve has a thick-walled spondylium duplex which is supported for a short distance by a stout, double-walled septum.

The internal structure of *P. manniensis*, in particular the abbreviated brachial plates, seems to be most like that found in *Stricklandia* and *Costistricklandia*, and it is suggested that *Platymerella* be placed in the family *Stricklandidae*.

The writer has examined Foerste's figured specimens of *"Platymerella manniensis"* (1920, pl. 23, figs. 5A-H) from Adams County, Ohio, which are at the U. S. National Museum. The brachial valve shown in Fig. 5,H, is believed to be a member of the Gypidulinae, possibly belonging to the genus *Gypidula*; the specimen shown in 5G is probably the same with the forward portion of the plates broken away. The specimens shown in figures 5E and 5F are more difficult to place but are not believed to be con-

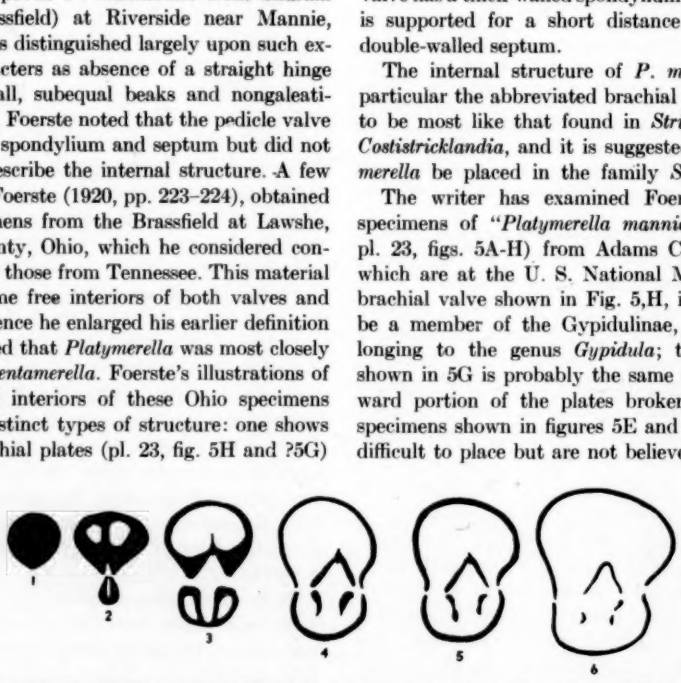

FIG. 4.—Serial sections of *Platymerella manniensis* Foerste (× 3). Silurian, Brassfield, Riverside near Mannie, Tenn. Peels of these sections at the U. S. National Museum. Pedicle valve above. Distance from posterior tip of pedicle beak: *1*—0.5 mm; *2*—1.2 mm; *3*—1.9 mm; *4*—2.1 mm; *5*—2.6 mm; *6*—3.3 mm.

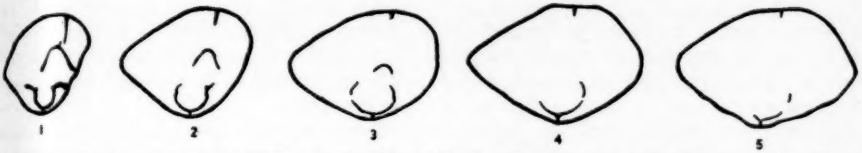

FIG. 5.—*Pentamerella areyi* (Hall and Clarke) (× 3). Irondequoit limestone, Clinton, N. Y. Peels of these sections at U. S. National Museum. Pedicle valve above. Distance from posterior tip of pedicle beak: *1*—2.5 mm; *2*—3.1 mm; *3*—4.0 mm; *4*—4.5 mm; *5*—4.9 mm.

generic with *P. manniensis* from Tennessee; they may be fragmentary individuals of a Gypidulinae, possibly *Sieberella*.

Pentamerella areyi (Hall and Clarke)

Fig. 5

Barrandella areyi Hall and Clarke, 1894, pp. 243, 368, pl. 71, figs. 14–16.

Hall and Clarke based this species upon specimens from the Clinton at Rochester, N. Y. In their description they covered only the external characters, no mention being made of the internal characters beyond noting that the pedicle valve had a well-developed spondylium. Through the courtesy fo Dr. G. A. Cooper, of the U. S. National Museum, the writer obtained a specimen of this species which was serially sectioned. As is shown in Fig. 5, *P. areyi* has a spondylium which is supported upon a fairly well-developed septum. The brachial valve has long, bladelike brachial processes which are supported upon outer plates that unite before reaching the floor of the valve. Inner plates are also present at the posterior end but these do not extend very far forward.

Hall and Clarke referred this species to *Barrandella* (=*Antirhynchonella*), but it differs from that genus in being multicostate. Its characters, both internal and external, are most like those of *Pentamerella*. *P. areyi* is considerably smaller than *P. arata* (genotype), but the external features are similar, both being multicostate and both having a brachial fold and pedicle sulcus. The brachial interiors are similar with the outer plates united to form a cruralium; in *P. areyi* these plates unite a short distance above the valve floor to form a double-walled septum. It is only in the pedicle valve that there are some slight differences; in *P. arata* the septum supporting the spondylium is very short whereas in *P. areyi* it extends forward as a complete plate for about a third the length of the valve and is continued beyond this as a ridge.

The reference of this species to *Pentamerella* is interesting because it greatly extends the known range of the genus. In 1932 Schuchert and Cooper (p. 176) gave the range as Middle and Upper Devonian. A few years later Khodalevich (1937, p. 68) described a species, *P. sosviensis*, from the Lower Devonian of the Urals. *P. areyi* extends the range back to the Middle Silurian.

Costistricklandia Amsden, n. gen.

Fig. 6

Genotype, *Stricklandia gaspéensis* Billings, 1859 (pp. 134–135; Hall and Clarke, 1894, pl. 73, fig. 11; Schuchert and Cooper, 1932, pl. 28, figs. 25, 27).

Description.—Shells variable in size but tending to be large with an oval or subcircular outline; hinge line straight, less than greatest width of shell; surface costate. Ventral interior with a spondylium duplex partially supported by a double-walled septum; spondylium usually of moderate length, extending a third or less the length of the valve; both spondylium and septum with thick walls. Brachial interior with long, rodlike brachial processes, which are unsupported by outer plates, their proximal ends attached to

FIG. 6.—Serial sections of *Costistricklandia gaspéensis* (Billings). (× 1). Middle Silurian, La Vieille formation, Black Cape, Quebec. Peels of these sections at the U. S. National Museum. Pedicle valve above. Distance from posterior tip of pedicle beak: *1*—0.9 mm; *2*—3.1 mm; *3*—3.6 mm; *4*—3.8 mm; *5*—4.5 mm; *6*—5.7 mm.

the posterior end of the valve; at the posterior end the brachial processes are directly overlain by outer plates which extend forward only a short distance.

Discussion.—In 1859 Billings (pp. 132–134) proposed the genus *Stricklandia*, including within it three English species, *Pentamerus lens* Sowerby, *Spirifer liratus* Sowerby, *Pentamerus laevis* Sowerby, and three Canadian species *Stricklandia gaspéensis* Billings, *S. canadensis* Billings and *S. brevis* Billings. No genotype was designated. A short time later, Billings (1863, p. 370) proposed to replace the name *Stricklandia* by *Stricklandinia* under the mistaken concept that his name *Stricklandia* was invalidated by prior usage for a plant. In 1887 Oehlert (p. 1310) selected *S. lens* as the genolectotype but almost all later workers have overlooked this and used Hall and Clarke's type designation of *S. gaspéensis* (1894, p. 251). Since Oehlert's designation clearly has priority over that of Hall and Clarke it must stand as the type.

The original description of *Stricklandia lens* (Sowerby in Murchison's Silurian System, 1839, p. 637, pl. 21, fig. 3) was based upon specimens from the Llandovery, Carmarthenshire, England. Recently St. Joseph (1937, pp. 323–330, text fig. 20–22, pls. 3, figs. 1–3, 7–9, 12–17; 4, figs. 12, 14; 8, figs. 10–19) has carefully redescribed this species, basing his description largely upon specimens from Norway although he also examined Sowerby's types. The internal characters appear to be very similar to those of *Costistricklandia gaspéensis*, with both species lacking outer plates; compare St. Joseph's text figures 20 and 21 to Fig. 6 of this report, and also his plate 8, figures 13 and 14, to plate 28, figure 25, of Schuchert and Cooper. The generic distinction between these two genera is based upon external characters, *Stricklandia* having a smooth shell and *Costistricklandia* being coarsely costate. They would seem to be closely related to one another and the difference between them is probably comparable to that separating *Pentamerus* from *Conchidium*.

PENTAMEROIDINAE Amsden, new subfamily

Description.—Rostrate, nongaleate Pentameridae. Pedicle interior with well-developed spondylium duplex. Brachial plates similar to the Pentamerinae but each plate consisting of four rather than three elements: inner plate, brachial process, outer plate, and septal plate.

A single genus, *Pentameroides* Schuchert and Cooper, is definitely referred to this subfamily. Two additional genera, *Pentamerifera* Khodalevich and *Conchidiella* Khodalevich, are provisionally included.

Discussion.—The genus *Pentameroides* was established by Schuchert and Cooper (1931, p. 248; 1932, p. 179) and included only one named species, *P. subrectus* (Hall and Clarke, 1894, p. 238, pl. 69, figs. 2, 3, 8–10), from the Silurian (Niagaran) of Jones County, Iowa. The writer has recently sectioned two specimens of the genotype which furnish details on the structure of this genus, in addition to the careful diagnosis given by Schuchert and Cooper. As is shown in Figs. 1C and 7, *Pentameroides subrectus* has a structure which is somewhat unusual for a pentameroid brachiopod. Each of the plates in the brachial valve consists of four elements: inner plate, brachial process, outer plate, and septal plate. These septal plates, which support the other elements, are discrete in their upper portion but unite with each other before reaching the floor of the valve, thus forming a double-walled septum. This structure and the terminology applied to it is similar to that used by Schuchert and Cooper (1932, text fig. 27) with this exception: These authors interpreted the outer plates as resting upon a single plate, the median septum, whereas the writer believes that the outer plates rest upon two plates, discrete at their junction with the outer plates, but coalescing before reaching the valve floor to make a double-walled septum. These are here called the septal plates. (Schuchert and Cooper call this the median septum in text fig. 27, but in the text, p. 165, they use septal plates.)

This structure is in contrast to the other subfamilies in the Pentameridae (Gypidulinae and Pentamerinae) where the brachial plates consist of three elements, inner plates, brachial processes and outer plates. In the Gypinulinae and Pentamerinae these outer plates may be discrete, or they may unit to form a cruralium, but in either case they rest directly upon the floor of the valve. A comparison of these different plate arrangements is shown in Fig. 1.

The terminology as herin used implies or suggests that the inner and outer plates of the Gypidulinae and Pentamerinae are homologous with the same named plates in the Pentameroidinae and that the septal plates of the latter are not developed in the other two subfamilies. Although such an interpretation is not unreasonable, it

can not be regarded as proven at the present time.

It is interesting and perhaps significant to compare *Pentameroides* with the loop-bearing pentameroid brachiopod, *Enantiosphen* (Whitlborne, 1893, p. 97). The writer has not had an opportunity to examine the internal characters of the latter, but Leidhold (1928, pp. 58–60, pl. 4, figs. 15, 16; pl. 5, figs. 1–3; Torley, 1934, pp. 93–96, pl. 5, figs. 9–10; Cloud, 1942, pp. 144–145, pl. 26, figs. 4–7) has given a good description based upon *E. vicaryi* (Davidson), from the Middle Devonian of Germany (the original description of this species was based upon specimens from the Middle Devonian of England). Leidhold describes the forward part of the brachial apparatus as consisting of four elements: Innere Cruralplatte, Crus, Äussere Cruralplatte, and Dorsales Medianseptum. The "crura" are overlain by the inner plates (Innere Cruralplatte) and underlain by the outer plates (Äussere Cruralplatte), the latter being supported by the median septum (Dorsal Medianseptum). The "crura" extend extend forward beyond the inner and outer plates to form a loop. This brachial structure, excluding the loop, is similar to that found in *Pentameroides*, a similarity that would be even more marked if the dorsal septum of *Enantiosphen* could be shown to consist of a double plate. It seems very possible that further studies of the genus *Enantiosphen* will show that the Enantiosphenidae and the Pentameroidinae are closely related.

St. Joseph (1937, pp. 286–292, pl. 5, figs. 7–8; pl. 6, figs. 13, 15; text figs. 1, 8) referred a species from the Silurian of southern Norway to *Pentameroides* (which he treated as a subgenus of *Pentamerus*). According to his description and illustrations of this species, *Pentamerus* (*Pentameroides*) cf. *gotlandicus* has a structure similar to that of a typical *Pentamerus* except the outer plates join just before reaching the floor of the valve. This author makes no mention of septal plates, nor do his illustrations show such a structure, and it therefore seems probable that the brachial plates of this species are not composed of 4 elements as they are in *Pentameroides*. *Pentamerus* (*Pentameroides*) cf. *gotlandicus* may represent a new genus which would have about the same structural relationship to *Pentamerus* that *Sieberella* has to *Gypidula* or that *Antirhynchonella* has to *Clorinda*. Since the writer has not examined specimens of the Norwegian species, it does not seem desirable to make such a generic distinction at this time.

In 1939 Khodalevich (pp. 96–97; pl. 14, figs.

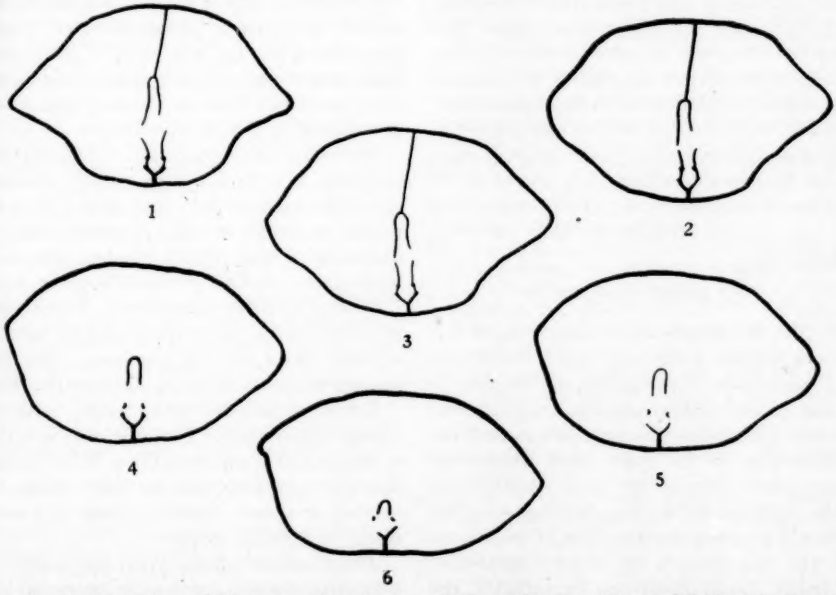

FIG. 7.—Serial sections of *Pentameroides subrectus* (Hall and Clarke). (× 1.5). Middle Silurian, Jones County, Iowa. Sections at the U. S. National Museum. Pedicle valve above. Distance from posterior tip of pedicle valve: *1*—13.5 mm; *2*—15.5 mm; *3*—16.8 mm; *4*—18.8 mm; *5*—19.5 mm; *6*—21.5 mm.

4a–4d; pl. 19, fig. 1) proposed a new genus, *Pentamerifera*, from the Upper Silurian of the Urals. This genus was described as being externally like *Pentamerus* and *Pentameroides*. The plates of the brachial interior were said to be discrete as in *Pentamerus*, but the structure of each of these plates was compared to *Pentameroides*, being divisible into inner, outer and septal plates with the brachial process lying between the outer and septal plates. Khodalevich was of the opinion that Schuchert and Cooper were in error when they described *Pentameroides* as having the brachial process between the inner and outer plates, believing that both *Pentamerifera* and *Pentameroides* had the brachial process between the outer and septal plates. The writer's studies of the type species of *Pentameroides* clearly indicates that Schuchert and Cooper placed the brachial process in the correct position. Therefore, on the basis of Khodalevich's description, the genus *Pentamerifera* would differ from *Pentameroides* not only in having discrete septal plates, but also in the position of the brachial process with respect to the other plate elements.

In this same paper, Khodalevich (1939, p. 100, text fig. 17) proposed a second pentameroid genus, *Conchidiella*. This was said to be internally like *Pentamerifera* but with external costae. This author figured several transverse sections of *Conchidiella* which show a structure which appears to have some similarities with the Gypidulinae. Since the writer has not had an opportunity to examine actual specimens of either genus, it is not possible to make any definite observations on the affinities of *Conchidiella* or *Pentamerifera*, but they may be provisionally placed in the Pentameroidinae.

CLASSIFICATION

In 1932 Schuchert and Cooper placed the following families in the superfamily Pentameracea: Camerellidae, Pentameridae, and Stricklandidae; the family Pentameridae was further divided into two subfamilies, the Gypidulinae and the Pentamerinae. A few years later Ulrich and Cooper (1938) removed the family Camerellidae to the Syntrophioidea, thus leaving only two families in the Pentameracea. The writer is in accord with this revision, but would suggest that the family Enantiosphenidae be included and that the new subfamily Pentameroidinae be added to the family Pentameridae. Following this modification in classification the superfamily Pentameracea, together with its families and subfamilies, may be diagnosed as follows:

Superfamily PENTAMERACEA. Shells variable in size but tending to be large; commonly strongly biconvex; exterior smooth, costellate, costate or rarely pitted. Pedicle interior with well developed spondylium duplex, usually supported on a double-walled septum, but in a few genera free. Lophophore supports consist of rod- or bladelike brachial processes; these processes unmodified except in the family Enantiosphenidae where they terminate in a loop; at the posterior end the brachial processes are supported on plates, usually extending forward sufficiently to enclose the brachial muscle field (Pentameridae, Enantiosphenidae) but which may be much shortened so as to exclude the muscle field (Stricklandidae). Impunctate.

FAMILY PENTAMERIDAE. Smooth, costellate or costate, rarely pitted, Pentameracea with well developed plates supporting the brachial processes; brachial plates may be discrete or may unite to form a cruralium, but in either case they always enclose the brachial muscle field.

SUBFAMILY GYPIDULINAE. More or less galeatiform Pentameridae, commonly strongly biconvex; fold and sulcus usually present; exterior smooth, multicostate, costate or pitted. Brachial apparatus tripartite, consisting of inner plates, brachial processes and outer plates; brachial processes broad and bladelike; outer plates discrete or coalesced to form a cruralium.

Subfamily PENTAMERINAE. Pentameridae of moderate to large size with smooth, costate or costellate exterior; fold and sulcus absent or poorly developed. Brachial apparatus tripartite, consisting of inner plates, brachial process and outer plates; brachial processes long and rodlike.

Subfamily PENTAMEROIDINAE. Pentameridae with the brachial plates quadripartite, consisting of inner plates, brachial processes, outer plates and septal plates; brachial processes rod-like.

Family STRICKLANDIDAE. Large, smooth or costate Pentameracea. Pedicle spondylium thick-walled, supporting septum thick, relatively short. Brachial apparatus with the outer plates much reduced or absent; brachial muscle field not enclosed by brachial plates.

Family ENANTIOSPHENIDAE. Specialized Pentameracea in which the brachial processes terminate in a loop; supporting plates quadripartite, consisting of inner plates, brachial processes,

outer plates and ? median septum (or ? septal plates).

The following list includes all the pentameroid genera known to the writer at this time:

Superfamily PENTAMERACEA Schuchert, 1896
Family PENTAMERIDAE McCoy 1844
Subfamily GYPIDULINAE Schuchert and LeVene, 1929
Gypidula Hall, 1867
Sieberella Oehlert, 1887
Pentamerella Hall, 1867
Antirhynchonella Oehlert, 1887 (syn. *Barrandella* Hall and Clarke).
Clorinda Barrande, 1879
Salonia Cooper and Whitcomb, 1933
Wyella Khodalevich, 1939
Clorindina Khodalevich, 1939
? *Metacamerella* Reed, 1917
Subfamily PENTAMERINAE Waagen 1883
* *Pentamerus* J. Sowerby, 1813
* *Conchidium* Oehlert, 1887 [= *Conchidium* "Linnaeus" of Authors]
Capelliniella Strand, 1928
Lissocoelina Schuchert and Cooper, 1931
Rhipidium Schuchert and Cooper, 1931
Harpidium Kirk, 1925
Brooksina Kirk, 1922
Cymbidium Kirk, 1926
Aliconchidium St. Joseph, 1942
? *Notoconchidium* Gill, 1951
? *Zdimir* Barrande, 1881
Subfamily PENTAMEROIDINAE Amsden, new
Pentameroides Schuchert and Cooper, 1931
? *Conchidiella* Khodalevich, 1939
? *Pentamerifera* Khodalevich, 1939
Family STRICKLANDIDAE Hall and Clarke, 1894
Stricklandia Billings, 1859
Costistricklandia Amsden, n. gen.
Platymerella Foerste, 1909
Holorhynchus Kiaer, 1902
? *Virgiana* Twenhofel, 1914
Family ENANTIOSPHENIDAE Torley, 1934
Enantiosphen Whidborne, 1893

* The status of the generic names *Pentamerus* and *Conchidium* is uncertain. E. S. Alexander (1951) has submitted a petition to the International Zoological Commission on Nomenclature to have these names added to the official list of genera.

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ENTOMOLOGY.—*Holarctic elements among the Ichneumoninae of Maine.* GERD H. HEINRICH, Dryden, Maine. (Communicated by A. B. Gurney.)

Until recently zoologists both of the United States and Europe have been strongly influenced by the belief that the New World was inhabited by a fauna totally different from that of the old Continent. The Palearctic and Nearctic subregions were considered as two clearly separated faunal regions. Slowly, however, the realization grew that this idea of the two worlds had to be modified, and science began the work of synthesis. It has become evident that besides the different endemic faunas of the northern parts of Eurasia and America there exists a rather considerable element of Holarctic species spread over the whole of the northern parts of both continents and that many species slightly different from one another in America and Eurasia have to be considered only as geographical subspecies of one and the same species. The purpose of this paper is to make a further contribution to our knowledge of such Holarctic elements.

In order to determine whether certain forms may belong together in the same species the consideration of biological facts and field observations seems to be not less important than the comparison of morphological characters; so I am using wherever possible the former as well as the latter for the following statements of Holarctic specific identities. I have not been able to find out in all cases whether the species identified below under the European names have already been described and recorded under American names. In other words, in some cases the synonymy remains unsettled. I am indebted to Prof. Henry K. Townes for the determination of the species described by Cresson and Provancher. I am unable to follow Townes in regard to the names of genera (Hymenoptera North of Mexico, 1951) because I acknowledge the decisions of the International Commission on Zoological Nomenclature which has ruled the names *Ichneumon*, *Pimpla*, *Ephialtes*, and *Cryptus* to be nomina conservanda.

Coelichneumon pumiliosimilis Heinrich ♀ ♂ (new record)

Orig. descr.: Bonner Zool. Beiträge 1951: 251. Described from northern Germany and the Alps.

The relatively small size, shape, and the particular type of coloration and proportions of joints of female antennae are identical with the type. Sides of scutellum white as is usual in the European males not only in the American male but also in all three American females (scutellum of the three known European females being entirely black). White marks of coxae I and II of the male larger than in European specimens.

2 ♀ ♀, 1 ♂ from Dryden, Maine, 1 ♀ from Carthage, Maine; ♀ ♂ compared with types.

Coelichneumon tauma Heinrich ♀ (new record)

Orig. descr.: Bonner Zool. Beiträge 1951: 253-254. Described from Austrian Alps.

Identical with type, even in such characters as the small white spots of the inner orbits on each side of the base of the antennae. Abdomen totally black, the brownish tint of segment 2-3 of the type evidently being accidental.

1 ♀ from Maine, bred from a pupa of Geometridae, by A. E. Brower; ♀ compared with type.

Coelichneumon calcatorius Thunberg (n. comb.) ♀ ♂ (new record)

Syn. *I. sylvanus* Holmgren.

White marks of inner orbits and upper margin of pronotum somewhat more extended than in my single European specimen (a female from Austrian Alps). Otherwise so identical that a subspecific separation does not seem to be possible.

1 ♀, 2 ♂ ♂ from Dryden, Maine; 2 ♂ ♂ from Maine, bred from *Olene* by A. E. Brower. (In spite of the identity of the shape of gastrocoeli with *Stenichneumon* Thomson this species does not fit into this genus in regard to the shape and areolation of propodeum. The new host record of Dr. A. E. Brower confirms this suggestion, because all typical species of the genus *Steinichneumon* Thomson are parasites of species of the genus *Plusia*.)

Stenichneumon militarius Thunberg subsp.? ♀ ♂

Females seem to be identical with European specimens.

The males which probably belong to them have antennae without white bands unlike the European males of the species. If this character should

be proved to be constant the American population would have to be considered as a different subspecies though distinguishable only in the male sex.

♀ ♂ Dryden, Maine, ♂♂ Maine, bred from pupae of a *Plusia* species by A. E. Brower.

Stenichneumon culpator Schrank subsp. *cincticornis* Cresson, ♀ ♂ (n. comb., n. status)

Ichneumon cincticornis Cresson, 1864.

Sculpture, proportion of joints of female antennae, and whole morphology identical with the type form, especially in the unique character consisting of the peculiarly shaped tooth of coxae III of the female.

Subspecifically different by the constant black color of the whole abdomen in both sexes which however occurs occasionally also in the European subspecies (var. *ater* Berth.), and by the constant largely yellowish banded antennae of the male (the antennae of European males usually being entirely black, exceptionally only white banded).

Ichneumon sarcitorius Linnaeus subsp. ♀ ♂ (new record)

Males do not show any differences from the European specimens.

Females differ as follows: End of hind femorae not black, hind part of third segment not clear red but somewhat yellowish in tint (as in some Oriental subspecies of this species); the fourth segment with a whitish outer margin.

Open fields are the habitat of the American subspecies as well as of the European and Oriental.

This species is spread over the most part of the Northern Hemisphere and goes south in Asia into Northern Persia. It splits into several subspecies (cf. Heinrich, Mitt. Deutsch. Ent. Ges. II, 1931; 27–29).

The above described form from Maine belongs doubtless to the same species as *sarcitorius jucundus* Brullé, named in 1846 from a specimen from "South America" and since recorded from Kansas and other localities in the United States but not yet, as far as I know, from Maine. I hesitate, however, to use Brullé's name for the subspecies of *sarcitorius* Linnaeus recorded from Maine, because the single female collected there and described above differs definitely in color from typical females of *jucundus* from more southern localities. This difference, as soon as proved to be constant instead of individual only, will indicate another (northern) subspecies in a certain degree intermediate between the Eurasian subspecies of *sarcitorius* and *sarcitorius jucundus*.

1 ♀, numerous ♂♂ Dryden, Maine.

Ichneumon languidus Wesmael subsp. *bimembris* Provancher ♀ (h. status)

Identical in color and all other characters with European specimens except that the antennae are slightly more slender.

♀♀ Dryden, Maine.

Ichneumon nereni Thomson (= **raptorius** auct.) subsp. ♀ ♂ (new record)

Female.—Basal joints of antennae reddish, fifth segment not white marked. (This coloration is rather common also in European specimens.) Antennae somewhat more slender.

Males agree well with European.

♀♀♂♂ Dryden, Maine.

Ichneumon deliratorius Linnaeus subsp. *cincitarsis* Provancher ♀ ♂ (n. status) (♀ a new record)

Female.—The particular type of coloration, scopula of coxae III and relatively deep gastrocoeli identical with European specimens. Proportions of segments of antennae similar, the latter however somewhat stouter in the American specimen.

Male.—Differs from European males in the partially white coxae and in the white annulus of each segment of tarsi III.

In contrast to the overwhelming majority of species of this genus the females of European *deliratorius* Linnaeus do not hibernate. Instead there are two generations, one in the spring, the second in the late fall. The American subspecies seem to show the same biological character; male and female were caught in the second half of September.

♀ ♂ Dryden, Maine.

Barichneumon anator Fabricius ♀ (new record)

Identical with the European specimens.

♀ Dryden, Maine.

Cratichneumon nigritarius Fabricius subsp. *acerbus* Cresson ♀ ♂ (n. status)

Female.—White marks of tibiae smaller, main color of legs darker, deep black.

Male.—Identical with the European speci-

mens except that the white stripe of inner orbits is more often lacking.

Males of this species in Europe have a particular, typical smell which I used as the best character for quickly distinguishing them in the field from other similar species. The American males smell just the same. Subspecies *nigritarius* Fabricius as the typical parasite of *Bupalus piniarius* is found only in or near coniferous woods. Subspecies *acerbus* Cresson also seems to prefer coniferous woods but is not confined to them.

Limerodops fossorius Linnaeus subsp. *belangeri* Cresson ♀ (n. comb., n. status)
Amblyteles Belangeri Cresson. 1877.

The American subspecies differs from the European only slightly in the somewhat more extended black color of the end of hind tibiae, in the nearly entirely or entirely black antennae, the black scutellum and the somewhat smaller size. In the high mountain region of Bavarian Alps (Allgäu) I found however a specimen *fossorius* Linnaeus which agrees exactly in all these points with *belangeri* Cresson, except for the less extent of black color on the end of tibiae III.

At the time he described *belangeri*, Cresson was in doubt as to its generic position and stated in the original description that it "probably belongs to Wesmael's subgenus *Limerodes*," which was my own former opinion about *fossorius* Linnaeus. The genus *Limerodops* Heinrich with the species *fossorius* Linnaeus as type was erected and described in Mitt. Münchener ent. Ges. **35-39:** 44-45. 1945–1949.

1 ♀ Dryden, Maine.

ENTOMOLOGY.—*A revision of the turtle bugs of North America (Hemiptera: Pentatomidae).* H. G. Barber and R. I. Sailer, U. S. Bureau of Entomology and Plant Quarantine.

The group of insects commonly known as turtle bugs form the tribe Podopini of the pentatomid subfamily Graphosomatinae. This tribe is composed of a rather homogeneous assemblage of genera, which look very much unlike the genera now placed in the typical tribe of the subfamily. Much additional study will be required before the relationship exhibited by the Podopini and the Graphosomatini can be properly evaluated.

As the Podopini are now known, the tribe has almost world-wide distribution in the Temperate and Tropical Zones. The tribe attains its greatest diversity in the Ethiopian Region, where 9 of the 18 recognized genera are found. Including the new genus described in this paper, there are now 6 genera in the New World. Only 4 species are known from the Neotropical Region, and of these, only 2 belong to an exclusively Neotropical genus. It seems likely that this feeble representation in the Neotropical Region is the result of inadequate collecting; otherwise the matter would be one of considerable zoogeographic interest.

So far as is known, all members of the tribe live in or near marshes among the roots of clumps of grass or sedge and under debris. They may also be found in similar environments along the margins of ponds, sloughs, and streams.

In addition to the material contained in the U. S. National Museum Collection (U. S. N. M.), and that contained in the senior author's personal collection, now deposited in the U. S. National Museum, many specimens were obtained through loan from the following institutions and individuals: University of Kansas Snow Museum (U. K. S. M.) through R. H. Beamer; Ohio State University Insect Collection (O. S. U. C.) through J. N. Knull; California Academy of Sciences (C. A. S.) through R. L. Usinger and E. P. Van Duzee; Mississippi Agricultural Experiment Station (M. A. E. S. C.); Patuxent Fish and Wildlife Research Refuge, through R. T. Mitchell; and the private collection of H. M. Harris, Ames, Iowa. All drawings were made by the junior author.

Tribe Podopini

1843. Podopides, Amyot et Serville; Hist. Nat. Insectes, Hemipteres: 56.
1851. Podopidae, Dallas; List Hempi. Ins. Brit. Mus., pt. 1: 51.
1859. Podopidae, Dohrn; Cat. Hemip.: 5.
1872. Pentatominae, Div. Podoparia, Stål, Öfv. Akad. Finska Vet. Soc. Förh. **29:** 34.

1884. Graphosomini, Tribe Podoparia, Jakovlev; Horae Soc. Ent. Ross. **18**: 204.
1893. Graphosomidae, Lethierry and Severin, Cat. Gen. Hemip. **1**: 49. (In part.)
1902. Graphosominae, Distant, Fauna Brit. India, Rhynch., **1**: 70. (In part.)
1904. Graphosomidae, Van Duzee, Trans. Amer. Ent. Soc. **30**: 21. (In part.)
1906. Graphosomatinae, Tribe Podoparia, Schouteden, Gen. Insectorum, fasc. 30: 28.
1908. Graphosomatinae, Bergroth, Mem. Soc. Ent. Belg. **15**: 145. (In part.)
1909. Pentatominae, Tribe Graphosomini, Kirkaldy, Cat. Hemip. **1**: 34, 222.
1912. Graphosominae, Tribe Podoparia, Oshanin, Kat. palä. Hemip.: 8.
1912. Graphosominae, Tribe Podopini, Zimmer, Contr. Univ. Nebraska Dept. Ent. no. 4: 20.
1915. Graphosomatinae, Tribe Podopini, Parshley, Psyche **22**: 171.
1917. Graphosomatinae, Tribe Podopini, Van Duzee, Cat. Hemip. N. Amer.: 25.
1919. Graphosomatinae, Hart, Bull. Illinois Nat. Hist. Surv. **13** (7): 166, 171.
1920. Graphosomatinae, Tribe Podopini, Stoner, Univ. Iowa Studies Nat. Hist. **8** (4): 48.
1923. Graphosomatinae, Tribe Podopini, Parshley, *in* Hemip. Connecticut: 754.
1926. Podopidae, Blatchley, Heterop. East. N. Amer.: 53.

FIG. 1.—A photographic reproduction of Palisot de Beauvois's illustration of "Scutellera dubia," Insectes recueillis Afrique et en Amérique . . . pl. 5, fig. 6, 1805.

1939. Graphosomatinae, Tribe Podopini, Torre-Bueno, Ent. Amer. **19**: 197.
1945. Podopidae, Brues and Melander, Class. Insects: 150.

Characters of the tribe: Scutellum enlarged, U-shaped, covering most of the abdomen and membranous part of the corium, leaving exposed a short triangular clavus and rather narrow coriaceous part of corium, the latter attenuated posteriorly, apex often extended nearly to end of scutellum; frena very short, much less than one-third the length of sutellum. Eyes prominent, more or less pedunculate. Antenniferous tubercles produced, sometimes in part, at least, visible from above. Bucculae strongly elevated posteriorly. Pronotum transversely impressed near the middle; a distinct tooth or process before the rounded humeral margin; anterolateral margin either lobate, toothed, or with an elongate spinelike process; anterior disk within the cicatrices often with tuberclelike elevations. The media and subcosta of the hind wings nearly parallel at base; hamus absent. Odoriferous orifices set a little closer to the posterior coxae than to the lateral margin of the metapleura, devoid of gutters; the surrounding evaporating surfaces, roughly, irregularly corrugated. Spiracles situated much closer to the anterior than to the lateral margins of the segments. Trichobothria single, situated behind the spiracles and nearly on a line with them. Posterior lateral angles of the abdominal segments slightly nodoform.

Within the tribe there appears to be two easily recognized subdivisions. Male members of the genus *Podops* and at least three of the five New World genera (males of the remaining two not being available for study) have a movable appendage attached to the posterolateral angles of the hypopygium which is subsequently referred to as the hypopygial appendage. This appendage is known to be absent in *Scotinophara*, *Stortheocoris*, *Melanophora* and *Aspidestrophus*.

KEY TO GENERA

1. Anterolateral margin of pronotum either with a subquadrate, denticulate lobe or an oblique cylindrical spine (see Figs. 2–4) 2
   Anterolateral margin of pronotum otherwise, usually with a more or less acute tooth (see Figs. 6, 10) 3
2. Anterolateral margin of pronotum with a subquadrate, denticulate lobe; juga inflated; pronotal cicatrices devoid of tubercles; devoid of a carina between the metasternal coxae . . . . . *Oncozygia* Stål

Anterolateral margin of pronotum with a cylindrical spinelike process; juga flattened; anterior disk of pronotum with a tubercle in each cicatrix; a slight longitudinal carina between posterior coxae. . . *Notopodops*, n. gen.

3. Preocular margin of head with a small acute spine; juga flattened, extended to apex of tylus; cicatrices of pronotum devoid of tubercles; rostrum long, extended to venter; antenna 4-segmented. . . . . *Allopodops* Harris

Preocular margin of head devoid of a spine; juga flattened; cicatrices of pronotum bearing distinct tubercles; rostrum shorter, extended to intermediate coxae; antenna 5-segmented. 4

4. Posterior coxae not contiguous, a short, metasternal sulcate carina between the coxae; juga much longer than tylus and contiguous before it; for the most part black *Weda* Schouteden

Posterior coxae contiguous or very nearly so, devoid of a metasternal sulcate carina; juga usually equally as long as the tylus or nearly so (except *brevitylus* and *vanduzeei*); fusco-cinerous. . . . . *Amaurochrous* Stål

Genus **Oncozygia** Stål

Oncozygia Stål, 1872, Enum. Hemip. **2**: 15; Van Duzee, 1904, Trans. Amer. Ent. Soc. **30**: 21; Schouteden, 1906, Gen. Insectorum, fasc. 30: 29; Kirkaldy, 1909, Cat. Hemip. **1**: 231; Hart, 1919, Bull. Illinois Nat. Hist. Surv. **13** (7): 171; Blatchley, 1926, Heterop. East. N. Amer.: 54; Torre-Bueno, 1939, Ent. Amer. **19**: 197; 1940, Bull. Brooklyn Ent. Soc. **35**: 51.

Preocular part of head little wider than long; tylus very short, vertex raised above the level of the juga, the extended apices of which are tumidly elevated, obtuse and sometimes contiguous. Antenniferous tubercles obtuse, scarcely visible from above. Rostral sulcus deep. Antennae short, each terminal segment nearly as long as the preceding four segments combined. Thorax strongly narrowed anteriorly; obtusely impressed across the middle; anterior disk within the cicatrices devoid of tubercles; anterolateral margin with a large subquadrate, denticulate lobe which projects well beyond outer margin of eye; a short, acute tooth before the rounded humeral margin.

The serrately margined, membranous flap which is attached basally to the inner face of the clasper and extends palmately from the two arms seems characteristic of this genus (see Fig. 21).

Type, *O. clavicornis* Stål (only included species).

Oncozygia clavicornis Stål

Figs. 4, 18, 21, 22, 23

Oncozygia clavicornis Stål, 1872, Enum. Hemip. **2**: 15; Van Duzee, 1904, Trans. Amer. Ent. Soc. **30**: 23; Schouteden, 1906, Gen. Insectorum, fasc. 30: 30, pl. 3, fig. 12; Blatchley, 1926, Heterop. East. N. Amer.: 54; Torre-Bueno, 1939, Ent. Amer. **19**: 197.

Small, not over 5 mm long; black, shining, rather closely and coarsely punctate; covered with decurved, appressed, cereous, clavate, often abraded hairs. Rostrum short, extending just past anterior coxae.

Outline of head and pronotum as in Fig. 4.

Hypopygium, hypopygial appendage, claspers, and aedeagus as in Figs. 22, 23, 21, 18.

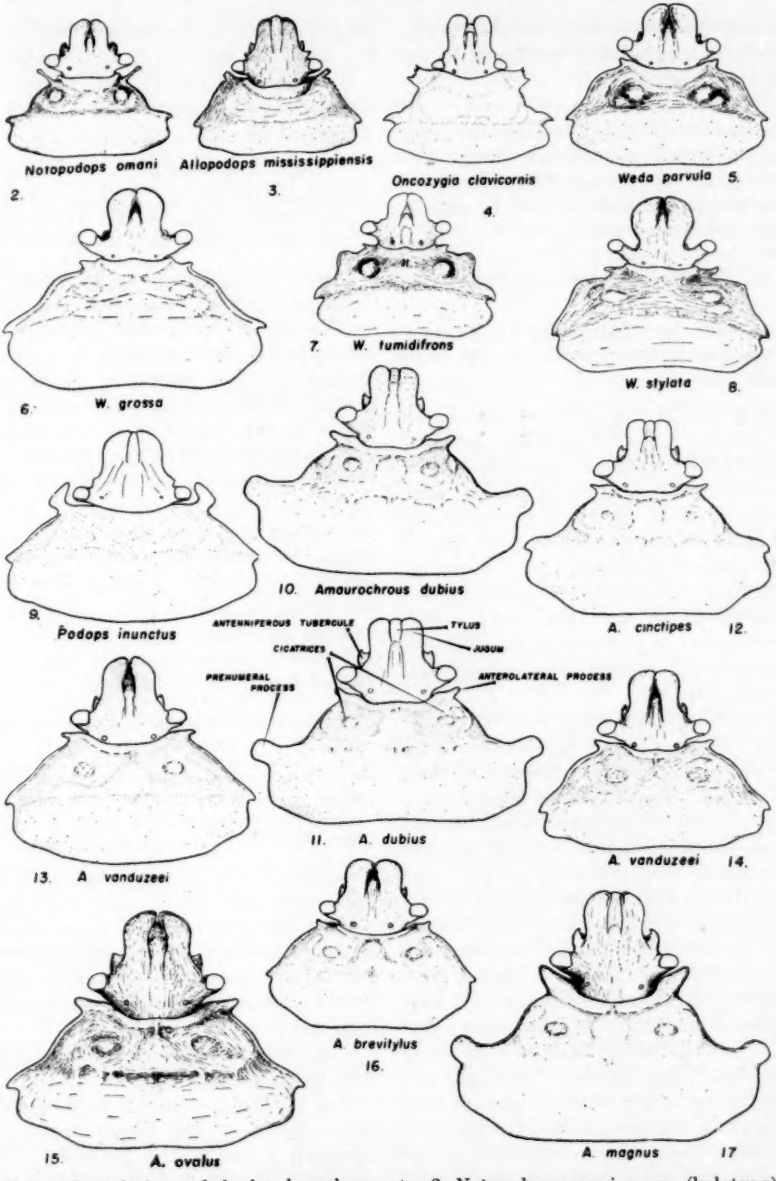
Stål described *clavicornis* from Texas. Since then it has been recorded from Fortress Monroe, Va., and from Ashby, Fla., by Torre-Bueno. The Vancouver, British Columbia, record cited by Hart is probably based on a misidentification.

Specimens have been examined from the following localities: *Virginia*: Fortress Monroe; *South Carolina*: Myrtle Beach (U.S.N.M.); *Florida*: Lake Placid (U.K.S.M.); *Mississippi*: Biloxi (M.A.E.S.C.), Wiggins (H. M. Harris Coll.); *Texas*: Galveston (U.S.N.M.), Gillespie County (O.S.U.C.).

O. clavicornis Barber (not Stål), 1906, was a mixed series one specimen of which is described under the following new genus.

Notopodops, n. gen.

Head much wider across eyes than long; eyes distinctly stylated; juga longer than tylus and contiguous before it; antenniferous tubercle with a prominent, stout, incurved, subacute process, this entirely visible from above; disk of vertex strongly elevated in a ridge which is continued anteriorly on the base of tylus, anteriorly, rather abruptly declivous. Antennae short, but little longer than the head. Rostrum short. Pronotum much wider than long, with two deep transverse impressions, the first somewhat remote from anterior margin, the second near the middle region, surface between these strongly elevated, more so in the center and provided on either side within the cicatrices with a prominent, rounded tubercle; lateral margins not explanate, lightly impressed for a short distance before the lateral sinus; just behind anterior angles armed with a slender, cylindrical, oblique, apically blunt process; prehumeral tooth not prominent. Outline of head and pronotum as shown in Fig. 2. Scutellum not twice as long as wide; surface deeply, obliquely impressed on each side from the basal angles. Connexivum narrowly exposed. Meta-



FIGS. 2–17.—Dorsal views of the heads and pronota: 2, *Notopodops omani*, n. sp. (holotype); 3, *Allopodops mississippiensis* Harris and Johnston (Falls Church, Va.); 4, *Oncozygia clavicornis* Stål (Myrtle Beach, S. C.); 5, *Weda parvula* (Van Duzee) (Fort Collins, Colo.); 6, *W. grossa*, n. sp. (holotype); 7 *W. tumidifrons*, n. sp. (holotype); 8, *W. stylata*, n. sp. (holotype); 9, *Podops inunctus* (F.) (Toulouse, France); 10, *Amaurochrous dubius* (P. de B.) (Cuba); 11, *A. dubius* (P. de B.) (Lake Placid, Fla.); WITH PARTS COMMONLY MENTIONED IN DESCRIPTION LABELED; 12, *A. cinctipes* (Say) (Staten Islend, N. Y.); 13, *A. vanduzeei*, n. sp. (holotype); 14, *A. vanduzeei*, n. sp. (Los Angeles, Calif.); 15, *A. ovalis*, n. sp. (holotype); 16, *A. brevitylus*, n. sp. (holotype); 17, *A. magnus*, n. sp. (holotype). (All drawn to the same scale.)

sternum between the posterior coxae provided with a slight, longitudinal, nonsulcate carina. Legs short and stout.

Type: *Notopodops omani*, n. sp.

Notopodops is related to *Weda* and is chiefly distinguished by the nonexplanate lateral margins of the pronotum, the spinelike anterolateral process of the pronotum, short antennae, and the nonsulcate metasternal carina.

Notopodops omani, n. sp.
Fig. 2

Oncozygia clavicornis, Barber (not Stål), 1909, Sci. Bull. Mus. Brooklyn Inst. Arts, Sci. **1**: 256 (in part).

Length female, 4 mm. Dull black, arenose, narrow lateral margin of the scutellum, anteriorly and inner field of the corium, testaceous yellow; basal and terminal segments of the antennae fuscous, second, third, and fourth as well as most of the rostrum testaceous; legs fuscous, tibia in the middle region and the tarsi brown. Punctures on the dorsal and ventral surfaces rather fine and rather closely placed, each beset with a fine, short, cereous hair, in part forming incrustations; inner field of the corium more coarsely and sparsely punctate.

Head, one-fifth wider across eyes than long, somewhat declivous, lateral margins before the anterior, deflexed portion nearly parallel for some distance, thence abruptly rounded toward apices of juga which meet before apex of tylus; the acute process of the antenniferous tubercles extends anteriorly almost to middle of the preocular part of head. Antennae with the basal segment moderately incrassate, somewhat longer than the second and third combined, third and fourth subequal, terminal rather strongly incrassate, almost equal to the three preceding segments combined. Rostrum almost attaining middle point of the mesosternum. Pronotum nearly twice as wide across posterior lobe as long. Outline of head and pronotum as in Fig. 2. Scutellum nearly one-third longer than wide, margins parallel anteriorly for a short distance thence slightly expanded, widest across middle region; apex not quite reaching end of abdomen; disk at base somewhat elevated, followed posteriorly by a more or less distinct carina which becomes evanescent posteriorly. Connexivum narrowly exposed. Male unknown.

Holotype: Female, Boca Chica, Cameron County, *Texas*, May 30, 1933, P. W. Oman, U.S.N.M. type no. 61516. Paratype: Female, Esperanza Ranch, Brownsville, Tex., C. Schaeffer, from the senior author's collection.

Named in honor of Paul W. Oman, who has collected many interesting Hemiptera from the western States.

Genus **Allopodops** Harris and Johnston

Allopodops Harris and Johnston, 1936, Iowa State College Journ. Sci. **10**: 377; Torre-Bueno, 1940, Bull. Brooklyn Ent. Soc. **35**: 51, 52.

Obtuse apex of tylus extended slightly beyond apices of juga; eyes somewhat pedunculate; a small, acute marginal process just before the eye; antenniferous tubercles visible from above, very slightly produced outwardly. Antennae 4-segmented. Ocelli but little further apart than each is removed from an eye, set close to anterior margin of pronotum, well behind a line drawn across posterior margins of eyes. Rostrum long, extended on to the venter. Pronotum with the lateral margins nearly straight, anteriorly, finely serrate behind the sinuatotruncate process at the anterior angle; devoid of prominent tubercles within the cicatrices. Devoid of a metasternal carina between the coxae.

Type: *Allopodops mississippiensis* Harris and Johnston (only included species).

Allopodops mississippiensis Harris and Johnston
Fig. 3

Allopodops mississippiensis Harris and Johnston, 1936, Iowa State College Journ. Sci. **10**: 378, pl. 1; Torre-Bueno, 1940, Bull. Brooklyn Ent. Soc. **35**: 52.

Length 5 mm. Black, sparsely pilose. The small acute preocular process, position of the ocelli, 4-segmented antennae, longer rostrum and serrated lateral margins and the character of the anterior pronotal angles distinguish this species from any other member of the tribe. Outline of head and pronotum as in Fig. 3.

This species was described from a single female collected at Wiggins, Miss.

Two additional specimens have been found in the collection of the United States National Museum: A female from Jocassee, *South Carolina*, June 25, 1935, O. L. Cartwright, and a male (hypopygium missing) from Falls Church, *Virginia*, November 8, 1943, collected on sedge by F. Andre.

Genus **Weda** Schouteden

Weda Schouteden, 1905, Ann. Soc. Ent. Belg. **49**: 150; 1906, Gen. Insectorum, fasc. 30: 42; Bergroth, 1908, Mem. Soc. Ent. Belg. **15**: 147;

Hart, 1919, Bull. Illinois Nat. Hist. Surv. **13** (7): 171; Torre-Bueno, 1939, Ent. Amer. **19**: 197, 198; 1940, Bull. Brooklyn Ent. Soc. **35**: 51.

Most closely related to the genus *Amaurochrous*. It differs chiefly by the characteristic black coloration, juga longer than tylus and more contiguous anteriorly, lateral margins of pronotum usually more expanded and reflexed. Most notable difference is the presence of a sulcate metasternal carina between the hind coxae.

Type: (*Weda horvathi* Schouteden) = *Weda parvula* (Van Duzee) (only included species).

KEY TO SPECIES OF WEDA

1. Lateral margin of pronotum strongly lobate midway between anterolateral and prehumeral tooth 2
   Lateral margin of pronotum not lobate, either gently, convexly rounded or obtusely angulated 3
2. Lateral margin of head scarcely contracted before the eyes; juga narrowly contiguous before apex of the tylus, longitudinal ridge on the vertex and base of tylus strongly depressed in the middle ... *tumidifrons*, n. sp.
   Lateral margin of head strongly contracted before the eyes; juga broadly contiguous before apex of tylus; longitudinal ridge on the vertex and base of tylus, viewed laterally, scarcely depressed in the middle . *stylata*, n. sp.
3. Head and pronotum subequal; lateral margins of head nearly straight and parallel; anterior and posterior lobes of pronotum subequally long; dull black; length 5 mm or less *parvula* (Van Duzee)
   Head much shorter than pronotum; lateral margins of head strongly contracted before eyes; anterior lobe of pronotum much shorter than posterior lobe; shining black; large species—6.40 mm ..... *grossa*, n. sp.

Weda parvula (Van Duzee), n. comb.

Figs. 5, 19, 24, 25, 26

Podops parvulus Van Duzee, 1904, Trans. Amer. Ent. Soc. **32**: 22 (part).

Weda horvathi Schouteden, 1905, Ann. Soc. Ent. Belg. **44**: 145; 1906, Gen. Insectorum, fasc. 30: 43; Bergroth, 1908, Mem. Soc. Ent. Belg. **15**: 147.

The following references to *parvulus* Van Duzee are erroneous and apply to *Amaurochrous brevitylus*, n. sp.:

Podops parvulus Van Duzee, 1904, Trans. Amer. Ent. Soc. **32**: 22 (part); Parshley, 1923, *in* Hemip. Connecticut: 755; Blatchley, 1926, Heterop. East. N. Amer.: 55–57; Torre-Bueno, 1939, Ent. Amer. **19**: 198.

Amaurochrous parvulus, Schouteden (not Van Duzee), 1906, Gen. Insectorum, fasc. 30: 33.

Length 5 mm. Dull black, densely punctate. Corium fuscotestaceous, very narrow margin of the connexivum, first three segments of antennae, rostrum and tarsi testaceous. Head nearly one-fourth wider across eyes than long; preocular lateral margins subparallel anteriorly; antenniferous tubercles slightly visible from above. Antennae with first, third, and fourth segments subequal, second segment shortest, somewhat shorter than basal, terminal segment but little shorter than the three preceding segments combined. Pronotum across humeral margins twice as wide as long; the acute process at anterior angle not extended beyond line of eyes; disk strongly, transversely impressed just before middle and also a little behind anterior margin; a distinctly elevated tubercle in each cicatrix; lateral margins lightly expanded, gently, convexly arcuate before the shallow, lateral sinus, thence very nearly straight to apex of acute prehumeral tooth, the latter extended but slightly beyond humeral margin. Outline of head and pronotum as in Fig. 5. Scutellum about one-third longer than wide, lateral margins nearly parallel anteriorly.

Hypopygium, hypopygial appendage, clasper and aedeagus as in Figs. 25, 26, 24, 19.

Podops parvulus Van Duzee, 1904, was described from a mixed series; however, the description was actually based on "a pair taken in Colorado." These have proved to belong to the species Schouteden described a year later as *horvathi* and which he made genotype of his new genus *Weda*. His specimens also came from Colorado. It therefore follows that *horvathi* Schouteden, 1905, must fall as a synonym of *parvulus* Van Duzee, 1904; however, *parvulus* must be transferred to Schouteden's genus *Weda*. The specimens from Montreal, Canada, Woods Hole, Mass., and Lawrence, Kans., which were also identified by Van Duzee as *parvulus*, belong to the genus *Amaurochrous* and must be described as a new species (see *A. brevitylus*, n. sp.). Schouteden's excellent figure, plate 3, figure 13, in the Genera Insectorum, mistakenly identified as *parvulus* Van Duzee, also pertains to this same new species of *Amaurochrous*.

A specimen belonging to the E. P. Van Duzee Collection, now deposited in the California Academy of Sciences, has been designated lectotype. It is a female labeled "*Podops parvula* Van Duzee, from Col. No. 238." Other specimens examined include 3 labeled "Col."; 2, Fort Collins, and 2

Manzanola, *Colorado* (in Colorado Exp. Stat. Coll.); 2, "Col.," No. 238 (Osborn Coll., deposited in A.S.U.C.); 2, Fort Collins, Colo., and 1 from Brigham, *Utah* (U.S.N.M.).

Weda tumidifrons, n. sp.
Figs. 7, 30, 31, 32

Oncozygia clavicornis, Barber (not Stål), 1906, Sci. Bull. Mus. Brooklyn Inst. Arts, Sci. **1**: 256 (in part).

Length 4 mm. Somewhat smaller than the two preceding species but of the same general fuscous coloration; corium testaceous. Head nearly one-fourth wider than long; lateral margins gently diverging before the strongly stylated eyes; antenniferous tubercles but very slightly visible from above; seen from the side, strongly elevated on the vertex and on the base of the tylus, lightly depressed between the two tumid-like elevations. Antennae as long as width of head across eyes, basal segment twice as long as second, a little longer than third, fourth one-fifth shorter than third and the terminal equal to the three preceding segments united. Apex of rostrum reaching to middle point of the intermediate coxae. Pronotum almost twice as wide across posterior lobe as long; acute process at anterior angle quite short, not extending outward as far as outer margin of eye; disk strongly impressed across the middle, anterior transverse impressions shallow, set closer to anterior margin than in *parvula*; tubercles in the cicatrices strongly elevated; expanded lateral margin anteriorly, strongly, convexly arcuate, sublobate before the lateral sinus; prehumeral tooth subacute, projecting a little beyond the humeral margin. Outline of head and pronotum as in Fig. 7.

Hypopygium, hypopygial appendage, and clasper as in Figs. 31, 32, 30.

Holotype: Male, Plano, *Texas*, July 1907, E. S. Tucker, U.S.N.M. type no. 61517. Paratypes: *Texas*: male, Esperanza Ranch, Brownsville, C. Schaeffer; male and female, College Station, April 8, 1928, H. G. Johnston; and May 20, 1928, J. C. Gaines; female, College Station, July 19, 1932, J. C. Gaines; *Colorado*: Boulder, November 5, 22, R. Shotwell; from the senior author's collection.

Distinguished from the preceding species by the two tumidescent elevations on the head and the sublobate anterolateral margin of the pronotum.

Weda stylata, n. sp.
Figs. 8, 27, 28, 29

Length 5.45 mm. Fuscous; coloration of parts much the same as in the three preceding species. Head a little wider than long; lateral margins before the strongly stylated eyes somewhat flaring anteriorly; preocular part of head half as long as entire head; antenniferous tubercles scarcely visible from above. Antennae but little longer than width of head; second segment about one-third shorter than basal, third one-fourth shorter than second, fourth but little shorter than third and the terminal somewhat shorter than the three preceding segments united. Apex of rostrum reaches to intermediate coxae. Pronotum not nearly twice as wide across posterior lobe as long; acute process at anterior angle extending outwardly but little beyond outer margin of eye; disk transversely impressed a little before the middle; anterior impression forming a shallow gutter; the anterior margin somewhat reflexed; expanded lateral margins before the sinus very strongly convexed, or obtusely angled, thence slightly, concavely arcuated opposite the median transverse impression; prehumeral process obtuse, projecting but slightly beyond the humeral margin. Outline of head and pronotum as in figure 8. Scutellum almost one-third longer than wide, obsoletely, longitudinally carinate in the middle.

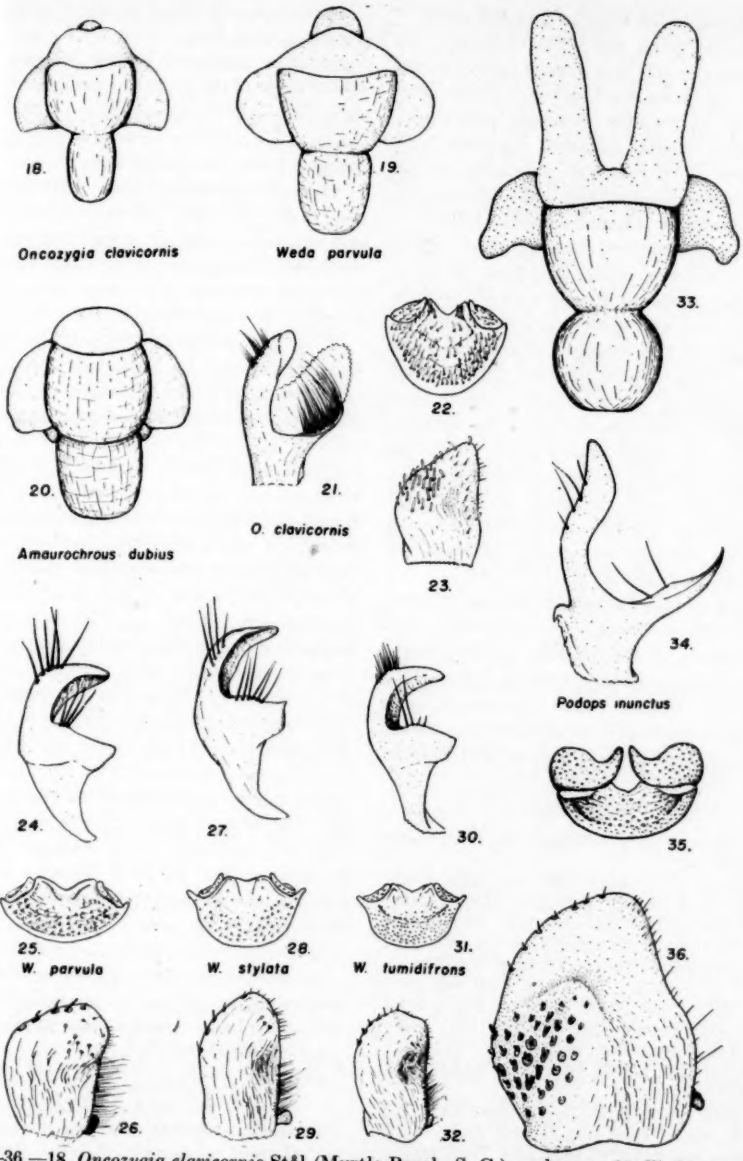
Hypopygium, hypopygial appendage, and clasper as in Figs. 28, 29, 27.

Holotype: Male, Salton, *California*, March 29, H. G. Hubbard, and paratype male from the same locality, March 26 (U.S.N.M. type no. 61518); paratype female, Coachella, Calif., May 21, 1928, E. P. Van Duzee (C.A.S.).

Most closely related to *tumidifrons*, but somewhat larger than that species. The preocular part of the head is relatively longer, lateral margins more flaring anteriorly; antenniferous tubercles scarcely visible from above; process at the anterior angle of pronotum longer and the lateral margins more shallowly sinuate opposite the median transverse impression.

Weda grossa, n. sp.
Fig. 6

Length 6.40 mm. Black, shining; antennae, rostrum and tarsi testaceous. Head wider across eyes than long; eyes strongly stylated; lateral margins strongly sinuate before eyes thence grad-



FIGS. 18–36.—18, *Oncozygia clavicornis* Stål (Myrtle Beach, S. C.), aedeagus; 19, *Weda parvula* (Van Duzee) (Fort Collins, Colo.), aedeagus; 20, *Amaurochrous dubius* (P. de B.) (Lake Placid, Fla.), aedeagus, 21, *Oncozygia clavicornis* Stål (Myrtle Beach, S. C.), right clasper; 22, same, posterior view of hypopygium; 23, same, dorsal view of right hypopygial appendage; 24, *Weda parvula* (Van Duzee) (Fort Collins, Colo.), right clasper; 25, same, posterior view of hypopygium; 26, same, dorsal view of right hypopygial appendage; 27, *W. stylata*, n. sp. (paratype, Salton, Calif.), right clasper; 28, same, posterior view of hypopygium; 29, same, dorsal view of right hypopygial appendage; 30, *W. tumidifrons*, n. sp., right clasper; 31, same, posterior view of hypopygium; 32, same, dorsal view of hypopygial appendage, 33, *Podops inunctus* (F.) (Toulouse, France), aedeagus; 34, same, right clasper; 35, same, posterior view of hypopygium; 36, same, dorsal view of hypopygial appendage. (All homologous parts drawn to the same scale.)

ually expanding to the broadly rounded apices of juga, each appearing somewhat spatulate anteriorly; juga coarsely and closely punctate; antenniferous tubercles short, entirely visible from above; bucculae strongly expanded posteriorly, lower margins broadly rounded. Antennae with the first and third segments subequal, second about one-fourth shorter than first and subequal to fourth, terminal segment as long as the two preceding segments united. Rostrum short, reaching only to anterior coxae. Pronotum twice as wide as long; subacute process at each anterior angle short, not extended outwardly as far as outer margin of the eye; prehumeral processes subacute, well projected beyond the rounded humeral margins; lateral margin before each process lightly expanded and narrowly reflexed, the lateral sinus rather shallow; disk before the median transverse impression coarsely punctate. Outline of head and pronotum as shown by figure 6. Scutellum nearly one-third longer than wide, rather coarsely and evenly punctate, especially towards base.

Holotype: Female, Mazatlán, Sinaloa, *Mexico*; U.S.N.M. type no. 61519.

Much larger and appearing more polished than any other known species of the genus. Head more strongly sinuate before the eyes than in *parvula*; antenniferous tubercles short, more obtuse; anterolateral process shorter and blunter.

Genus **Amaurochrous** Stål

Podops, subgenus *Amaurochrous* Stål, 1872, Enum. Hemip. **2**: 15.

Amaurochrous Schouteden, 1905, Gen. Insectorum, fasc. 30: 32; Kirkaldy, 1909, Cat. Hemip. Heterop. **1**, Cimicidae: 237; Zimmer, 1912, Contr. Dept. Ent. Univ. Nebraska, no. 4: 20; 1912, Univ. Nebraska Studies **11**: 238; Van Duzee, 1917, Cat. Hemip. N. Amer.: 26 (subgen.); Hart, 1919, Bull. Illinois Nat. Hist. Surv. **13** (7): 171; Barber and Bruner, 1932, Journ. Dept. Agr. Puerto Rico **16**: 246.

Scotinophara Stål, 1867, Öfv. Vet.-Akad. Förh. **24**: 523.

Podops Uhler, 1878, Proc. Boston Soc. Nat. Hist. **19**: 368; 1886, Check List Hemip. Heterop.: 5; Lethierry and Severin, 1893, Cat. Gen. Hemip; **1**: 55; Van Duzee, 1904, Trans. Amer. Ent. Soc. **30**: 21, 22; Bergroth, 1908, Mem. Soc. Ent. Belg. **15**: 146; Banks, 1910, Cat. Nearctic Hemip. Heterop.: 92; Parshley, 1915, Psyche **12**: 171; Parshley, 1923, *in* Hemip. Connecticut: 755; Blatchley, 1926, Heterop. East. N. Amer.: 54; Torre-Bueno, 1939, Ent. Amer. **19**: 197; 1940, Bull. Brooklyn Ent. Soc. **35**: 51.

Fuscocinereous. Head shorter than pronotum. Antennae each 5-segmented, with a tendency for fusion of the second and third segments. Anterolateral angle of the pronotum produced in a short subacute tooth or an elongate hornlike process which in some species extends well beyond outer margin of the eye; prehumeral process subacute to obtusely rounded at apex; lateral margin of pronotum concavely sinuate (except *brevitylus* and *vanduzeei*); well-developed tubercles in the cicatrices. Hypopygeal appendages widely separated, not overlapping the deep, concave, median sinus on the hind margin of the hypopygial cup.

Type: *Amaurochrous dubius* (Palisot de Beauvois) (designated by Schouteden in 1905).

As indicated in the bibliography above, there has been considerable disagreement among past authors as to the position of *Amaurochrous*. Some recent writers have gone so far as to treat the name as a synonym of *Podops* Laporte, 1832. Superficially the species belonging to these genera do show a close similarity; however, closer scrutiny quickly reveals important differences. The shape of the process at each anterolateral angle is noticeably different. In *Podops* it is flattened and spatulate, in *Amaurochrous* it is conical or tuberculate (comp. Figs. 9 and 10). Striking differences are apparent in the male genitalia. With minor variations the claspers of all species of *Amaurochrous* conform to the pattern exhibited by the genotype *dubius* (Fig. 49) which is quite different from *Podops inunctus* (Fabricius) (Fig. 34). The bilobed dorsal vesicula of the aedeagus (Fig. 33) and very much enlarged hypopygeal appendages (Fig. 36) of *P. inunctus* are also unlike the homologous structures of *A. dubius* and its related species.

KEY TO SPECIES OF AMAUROCHROUS

1. Tylus and juga equal or very nearly so.....2
   Juga evidently longer than tylus and often contiguous before it.....4
2. Rostrum long, extended past metasternal coxae; anterolateral tooth of pronotum produced in an elongate, hornlike process extended obliquely well beyond outer margin of eye.....*magnus*, n. sp.
   Rostrum shorter, scarcely extended beyond mesosternal coxae; anterolateral tooth of pronotum, short, acute or subacute, at most extended but little beyond outer margin of eye.....3
3. Anterolateral tooth of pronotum, acute, smaller, not projected beyond outer margin of eye; prehumeral process narrowly rounded

to subacute, extended but little, if at all, beyond humeral margin (Fig. 12)
cinctipes (Say)

Anterolateral tooth of pronotum stout, extended a little beyond outer margin of eye; prehumeral process forming a broadly rounded lobe projecting well beyond humeral margin (Fig. 10)
dubius (Palisot de Beauvois)

4. Lateral margin of pronotum distinctly concavely sinuate in the middle (Fig. 15)
ovalis, n. sp.

Lateral margin of pronotum fairly straight, scarcely concavely sinuate (Figs. 13 and 16) .5

5. Anterolateral tooth of pronotum scarcely extended as far as outer margin of eye; antennae shorter, but little longer than pronotum; ocelli less widely separated (Eastern and Middle West) (*parvulus* of most authors)
brevitylus, n. sp.

Anterolateral tooth extended a little beyond outer margin of eye; antennae much longer than pronotum; ocelli more widely separated (California) ..... *vanduzeei*, n. sp.

Amaurochrous dubius (Palisot de Beauvois)

Figs. 1, 10, 11, 20, 49, 50, 51

Scutellera dubia Palisot de Beauvois, 1805, Ins. Afr. Amer.: 33, pl. 5, fig. 6 (reproduced on our Fig. 1).

Podops (*Amaurochrous*) *dubius*, Stål, 1872, Enum. Hemip. **2**: 15; Van Duzee, 1917, Cat. Hemip. N. Amer.: 26 (part).

Amaurochrous dubius, Schouteden, 1905, Gen. Insectorum, fasc. 30: 33; Kirkaldy, 1909, Cat. Hemip. Heterop. **1**, Cimicidae: 237; Bruner and Barber, 1949, Mem. Soc. Cubana Hist. Nat. **19**: 156.

Podops peninsularis Blatchley, 1924, Ent. News **35**: 87; 1926, Heterop. East. N. Amer.: 55, 56; Torre-Bueno, 1939, Ent. Amer. **19**: 198. NEW SYNONYMY.

This has the same general appearance and size as *cinctipes* but differs in the following respects: The anterolateral tooth of the pronotum is stouter and extended somewhat beyond the outer margin of the eye; the prehumeral process is broadly rounded or lobate and extended well beyond the humeral margin, and preceded by a more strongly concave sinus (compare outlines of the heads and pronota as shown in Figs. 10 and 12).

Palisot de Beauvois described *dubius* from San Domingo; Stål reported the species from Cuba. Specimens have been examined from Cuba, Florida, and Louisiana. In addition, the U. S. National Museum collection contains a number of specimens from Mexico and Central America intercepted in cargoes of bananas.

Blatchley, 1926, described *peninsularis* from Florida. A paratype in the collection of the U. S. National Museum agrees with what we have determined as *dubius* from Cuba and Florida. In our opinion Blatchley was in error both in his description (pp. 55–56) and in his identification (Fig. 11) of Palisot de Beauvois' species; in consequence he redescribed the true *dubius* as *peninsularis*. A photographic reproduction of Palisot de Beauvois's illustration of *dubius* is shown on Fig. 1.

There is some reason to question the status of *cinctipes* as a species distinct from *dubius*. Certain specimens of *dubius* from Mexico and several specimens from Texas which we identify as *cinctipes* tend to intergrade. It may be that additional material collected along the zone where *dubius* overlaps with *cinctipes* will show *cinctipes* to be a subspecies of *dubius*. This opinion is further supported by the slight degree of difference exhibited by the claspers and hypopygial appendages of the two species (compare Figs. 49, 50 and 40, 42).

Amaurochrous cinctipes (Say)

Figs. 12, 40, 41, 42

Tetyra cinctipes Say, 1828, Amer. Ent. **3**: 94, pl. 43; LeConte, 1859, Compl. Writ. Say **1**: 94, pl. 43, fig. 4.

Scotinophara cinctipes, Stål, 1867, Öfv. Vet.-Akad. Förh. **24**: 502.

Podops (*Amaurochrous*) *cinctipes*, Stål, 1872, Enum. Hemip. **2**: 15; Van Duzee, 1917, Cat. Hemip. N. Amer.: 26; Leonard, 1928, List Insects New York: 78.

Amaurochrous cinctipes, Olsen, 1912, Journ. New York Ent. Soc. **20**: 49.

Podops cinctipes, Uhler, 1886, Check List Hemip. Heterop.: 5; Lethierry and Severin, 1893, Cat. Gen. Hemip. **1**: 56; Van Duzee, 1894, Bull. Buffalo Soc. Nat. Sci. **5**: 170; 1904, Trans. Amer. Ent. Soc. **30**: 22; Torre-Bueno, 1907, Ent. News **18**: 441; 1908, Journ. New York Ent. Soc. **16**: 226; Banks, 1910, Cat. Nearctic Hemip. Heterop. 92; Zimmer, 1912, Univ. Nebraska Studies **11**: 238; 1912, Contr. Dept. Ent. Univ. Nebraska no. 4: 20; Stoner, 1915, Ent. News **27**: 355; Parshley, 1915, Psyche **22**: 171; 1917, Occ. Pap. Boston Soc. Nat. Hist. **7**: 6; Stoner, 1917, Bull. Lab. Nat. Hist. Univ. Iowa **7**: 6; Parshley, 1923, Can. Ent. **45**: 69–70, figs. 1, 2 (ecology); 1923, *in* Hemip. Connecticut: 755; Blatchley, 1926, Heterop. East. N. Amer.: 55; Brimley, 1938, Insects North Carolina: 61; Torre-Bueno, 1939, Ent. Amer. **19**: 198.

Podops peninsularis, Torre-Bueno (not Blatchley), 1939, Bull. Brooklyn Ent. Soc. **34**: 214.

Length 5–7.5 mm. Head across eyes much wider than long; preocular portion, viewed dor-

sally, subequal to remainder; tylus and juga equally long; antennae nearly one-fourth longer than head; first four segments nearly equal, fifth but little longer than the preceding two segments combined. Pronotum across humeri over twice as wide as long, a little longer than head; lateral margin very narrowly impressed and reflexed; anterolateral tooth acute, extended outward almost to outer margin of eye; prehumeral process subacute to narrowly obtusely rounded at apex, extended but little beyond humeral margin, lateral margin before this rather strongly concavely sinuate. Outline of the head and pronotum as shown by Fig. 12. Scutellum over twice as long as pronotum, one-fourth longer than head and pronotum combined.

Distribution: Eastern North America from Quebec and the New England States south to the Carolinas and west to Minnesota, Nebraska, Kansas, Missouri, and extending south into Louisiana and Texas.

Two specimens in the collection of the U. S. National Museum, which bear the label "along Black R., 3 mi. so. of Carlsbad Cave, N. Mex.," apparently belong here although the genital structures are not exactly typical of the species.

Hypopygium, hypopygial appendages, and clasper as in Figs. 41, 42, 40.

As noted in the discussion under *A. dubius*, there is some reason to believe that *cinctipes* is actually no more than a subspecies of *dubius*. Certainly the differences distinguishing these two species are not of the same order as those which distinguish them from the other species of the genus.

Amaurochrous brevitylus, n. sp.

Figs. 16, 37, 38, 39

Podops parvulus Van Duzee, 1904, Trans. Amer. Ent. Soc. **30**: 22 (part); Bergroth, 1908, Mem. Soc. Ent. Belg. **15**: 146; Banks, 1910, Cat. Nearc. Hemip. Heterop.: 93; Zimmer, 1912, Contr. Dept. Ent. Univ. Nebraska no. 4: 20; Stoner, 1917, Bull. Lab. Nat. Hist. Univ. Iowa **7**: 6; Parshley, 1923, *in* Hemip. Connecticut: 755; Blatchley, 1926, Heterop. East. N. Amer.: 55–57; Torre-Bueno, 1939, Ent. Amer. **19**: 198.

Amaurochrous parvulus, Schouteden (not Van Duzee), 1906, Gen. Insectorum, fasc. 30: 33, pl. 2, fig. 13; Hart, 1919, Bull. Illinois Nat. Hist. Surv. **13** (7): 171.

Amaurochrous dubius, Olsen (not Palisot de Beauvois), 1912, Journ. New York Ent. Soc. **20**: 50.

Length 5.30–5.80 mm. Head distinctly wider, across eyes, than long; preocular part distinctly longer than remainder; juga distinctly longer than tylus, usually not contiguous anteriorly; lateral margin slightly concave before stylated eyes. Antenna with basal segment a little longer than second, the latter subequal to the third and fourth, fifth very nearly equal to the preceding three segments combined. Pronotum about twice as wide as long; lateral margin very nearly straight, anterolateral tooth of pronotum acute, scarcely extended beyond outer margin of eye; prehumeral process forming an obtuse tooth. Outline of head and pronotum as shown in Fig. 16. Scutellum about one-third longer than wide, over twice as long as head and pronotum combined.

Hypopygium, hypopygial appendage, and clasper as in Figs. 38, 39, 37.

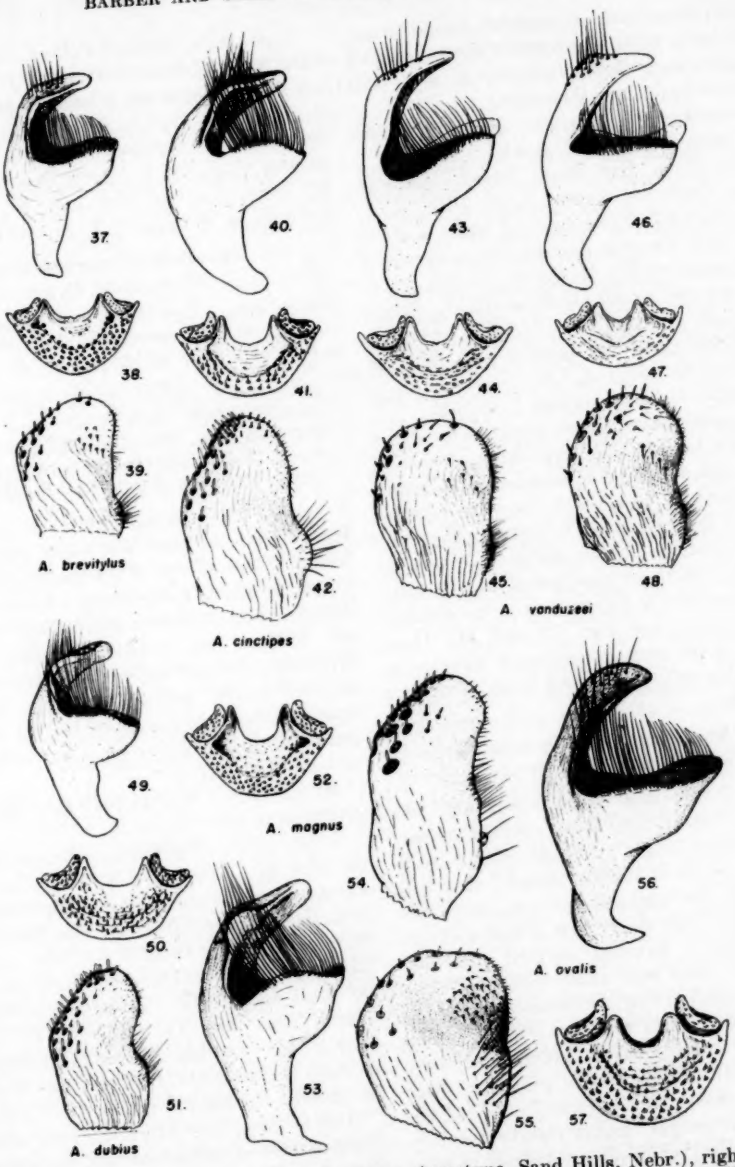
Type: Male, *Massachusetts*: Waterton, June 28, 1920, C. C. Sperry, U.S.N.M. type no. 61520. Paratypes, males and females: 1, Andover, ex P. R. Uhler collection. *New York*: 1, Northwest, L. I., June 14, 1949, Roy Latham; 1, Orient, L. I., May 28, 1932, Roy Latham. *New Jersey*: 1, Paterson, May 3, 1903, H. G. Barber. *Wisconsin*: 1, Madison, June 1, 1949, student collection. *Minnesota*: 1, Park Rapids, July 24, 1935, P. W. Oman. *Iowa*: 2, Lake Okoboji, June 25, 1916; 4, July 1916, L. Buchanan; 1, July 8, 1916, O. Stoner; Ames, July 5, 1932, H. M. Harris; 1, Solon, May 17, 1915, L. Buchanan; 1, Esterville, June 5, 1916, L. Buchanan. *Nebraska*: 1, Sand Hills, July, H. G. Barber. *Kansas*: 3, Topeka, May 30, Popenoe; 1, "Kan."; 2, Douglas County, 900 feet, F. H. Snow; 1, October 9, 1946. *Arizona*: Mount Lemon, April 29, 1948, R. H. Beamer.

Fourteen of the paratypes listed above are in the U. S. National Museum collection; four are in the Snow Insect Collection of the University of Kansas; one, in the University of Wisconsin Collection; and one is in the private collection of H. M. Harris.

Amaurochrous vanduzeei, n. sp.

Figs. 13, 14, 43–48

Length 6–7 mm. Head across eyes nearly one-third wider than long; juga longer than tylus, and often contiguous before it. Antenna with second segment shorter than the basal, third a little longer than fourth and the fifth equal to third and fourth combined. Pronotum twice as wide as long; anterolateral tooth acute, extending directly outward a little beyond outer margin of eye; lateral margin very nearly straight; pre-



FIGS. 37–54.—37, *Amaurochrous brevitylus*, n. sp. (paratype, Sand Hills, Nebr.), right clasper; 38, same, posterior view of hypopygium; 39, same, dorsal view of hypopygial appendage; 40, *A. cinctipes* (Say) (Staten Island, N. Y.), right clasper; 41, same, posterior view of hypopygium; 42, same, dorsal view of hypopygial appendage, 43, *A. vanduzeei*, n. sp. (paratype, Bay Farm Island, Alameda County, Calif.), right clasper; 44, same, posterior view of hypopygium; 45, same, dorsal view of hypopygial appendage; 46, *A. vanduzeei*, n. sp. (paratype, Los Angeles, Calif.), right clasper; 47, same, posterior view of hypopygium; 48, same, dorsal view of hypopygial appendage; 49, *A. dubius* (P. de B.) (Lake Placid. Fla.), right clasper; 50, same, posterior view of hypopygium; 51, same, dorsal view of hypopygial appendage; 52, *A. magnus*, n. sp. (paratype, Florida, ex Uhler coll.); 52, same, posterior view of hypopygium; 53, same, right clasper; 54, same, dorsal view of hypopygial appendage; 55, *A. ovalis*, n. sp. (holotype); 55, same, dorsal view of hypopygial appendage; 56, same, right clasper; 57, same, posterior view of hypopygium.

humeral process narrowly rounded, extending but little beyond humeral margin. Outline of head and pronotum as shown by figure 13. Scutellum about one-third longer than wide.

Hypopygium, hypopygial appendage and clasper as in figures 44, 45, and 43.

Type: Male, Bay Farm Island, Alameda County, *California*, February, 25, 1939, K. S. Hagen (C.A.S.). Paratypes: 12 males and 18 females with the same data as type; male and 2 females, same locality, November 11, 1938, W. F. Barr; male and female, Millbrae, Calif., August 25, 1918, E. P. Van Duzee (C.A.S.). Five male and 5 female paratypes agreeing with the type are retained for the U.S.N.M. collection; male, Los Angeles, Calif., Coquillett (U.S.N.M.).

This species is most closely related to *brevitylus*, new species, but averages larger than that species; the antennae are longer in relation to the length of the pronotum. In addition there are constant differences in the genital structures. The male from Los Angeles County differs in certain respects from the form represented by the type. The most noticeable difference is in the shape of the head. (Compare Figs. 13 and 14.) Close similarity of the genital structure is accepted as evidence that only one species is involved. (See Figs. 43–48.)

Amaurochrous ovalis, n. sp.
Figs. 15, 55, 56, 57

Length 7–8.00 mm. Head about one-third wider across than long; juga, coarsely, closely punctate, much longer than tylus but scarcely contiguous before it, bluntly rounded at apices. Antenna with the basal and second segments subequal, third a little longer than second and subequal to fourth, terminal segment somewhat shorter than third and fourth combined. Pronotum very nearly twice as wide across humeri as long, but little longer than head; anterolateral tooth rather stout, subacute, extending directly outward a little beyond outer margin of eyes; prehumeral process subacute, well extended beyond humeral margin; lateral margin narrowly pressed, marginal sinus rather shallow. Outline of head and pronotum as shown in Fig. 15. Scutellum about one-third longer than wide, not quite reaching apex of abdomen.

Hypopygium, hypopygial appendage, and clasper as in figs. 57, 55, 56.

This is a larger species than *cinctipes* with the body appearing somewhat oval in outline.

Type: Male, Clemson College, *South Carolina*, June 26, 1932, O. L. Cartwright, U.S.N.M. type no. 61521. Paratypes: 2 females, Mrytle Beach, S. C., April 23, 1919, E. R. Kalmbach (U.S.N.M.) Benson, *North Carolina*, August 9, 1934, R. H. Beamer (U.K.S.M.); Myrtle Beach, S.C., April 22, 1919, Patuxent Fish and Wildlife Refuge Laboratory, through R. T. Mitchell.

Amaurochrous magnus, n. sp.
Figs. 17, 52, 53, 54

Podops dubius, Van Duzee (not Palisot de Beauvois), 1904, Trans. Amer. Ent. Soc. **30**: 77; Blatchley, 1926, Heterop. East. N. Amer.: 55–56, fig. 11.

Amaurochrous dubius, Barber (not Palisot de Beauvois), 1914, Bull. Amer. Mus. Nat. Hist. **33**: 521; Hart, 1919, Bull. Illinois Nat. Hist. Surv. **13** (7): 172; Barber and Bruner, 1932, Journ. Dept. Agr. Puerto Rico **16**: 246.

Length 7.70–8.00 mm. This is a much larger species than *cinctipes* and easily distinguished from all other species of the genus by the much longer, hornlike, anterolateral tooth of the pronotum which is extended well beyond outer margin of eye; the enlarged bluntly rounded prehumeral process which projects well beyond humeral margin and especially by the much longer rostrum which extends beyond the metasternal coxae. Outline of head and pronotum as shown in figure 17.

Hypopygium, hypopygial appendage and clasper as in Figs. 52, 54, 53.

Type: Male, Edgewater, *Florida*, February 28, 1939, C. A. Frost, U.S.N.M. type no. 61522. Paratypes, males and females: Edgewater, Fla., same data as type; Haulover, Fla., March, Hubbard and Schwarz; Paradise Key, Fla., February 23, 1919, H. S. Barber; Georgia, 8 specimens, no data, colln. P. R. Uhler, U.S.N.M.; Lake Placid, Fla., July 13, 1948, R. H. Beamer (U.K.S.M.); Gueydan, *Louisiana*, June 26, 1925, at light, E. Kalmbach, Patuxent Fish and Wildlife Refuge Laboratory, through R. T. Mitchell.

This is the species which has been misidentified as *dubius* by several authors, but comparison with Palisot de Beauvois's figure 6 on plate 5 indicates very clearly that this is an error. (See Fig. 1.)

Van Duzee (1904, Trans. Amer. Ent. Soc. **30**: 77) reports a pair taken at Fortress Monroe, Va. As these specimens are no longer in the collection of the U. S. National Museum, it is impossible to confirm this record.

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ZOOLOGY.—*A new crawfish of the genus* Procambarus *from Louisiana and Arkansas* (*Decapoda: Astacidae*).

GEORGE HENRY PENN, Tulane University of Louisiana, New Orleans. (Communicated by Fenner A. Chace, Jr.)

The new species described here has been known to me for more than 10 years; however, all the specimens in collections were immature, and my efforts to obtain mature forms proved fruitless. Recently Maj. Thomas H. Nickerson, U.S.A.F., at Louisiana Polytechnic Institute, Ruston, La., succeeded in collecting a small series of mature specimens in north-central Louisiana; these include the holotype and allotype and the majority of the paratypes. Major Nickerson has kindly lent me his entire collection as well as his field notes.

I have named this species in honor of Paul Tulane (1801–1887), who in 1884 gave a substantial part of his fortune to the University of Louisiana, founded half a century before, thus enabling it to greatly expand facilities. The administrators of this fund subsequently added the name of Tulane to the existing title of the University.

Procambarus tulanei, n. sp.
Figs. 1–12

Holotype male, form I.—Body ovate; abdomen slightly shorter than length of cephalothorax (53.0–51.0). Height of cephalothorax (Figs. 1, 2) equal to width in region of caudodorsal margin of cervical groove.

Areola wide, with three punctations in narrowest part; length about 7.3 times greater than width at narrowest part (18.0–2.3). Cephalic portion of cephalothorax about twice as long as the areola; length of areola about 34 percent of entire length of cephalothorax.

Rostrum spatulate, relatively short and wide; sides converging anteriorly to the base of the acumen; without lateral spines or shoulders; acumen short. Margins of rostrum raised, keeled, and not swollen; upper surface smoothly excavate.

Postorbital ridges well-developed, terminating anteriorly in rounded shoulders. Branchiostegal spine obsolete. Without lateral spines on sides of cephalothorax; upper surface of cephalothorax sparsely punctate; lateral portions finely granulate.

Cephalic section of telson with two spines in each caudolateral corner, the lateral one about three times the length of the median one.

Length of epistome (Fig. 3) about two-thirds of width; margins raised and slightly swollen; with a small anterior projection.

Antennae reaching to end of abdomen. Antennal scale wide (Fig. 4), greatest width distad of middle; lateral margin terminating distally in a sharp spine; total length a little less than half the length of the areola (8.3–18.0). Entire median margin fringed with hair.

Exposed (caudal) surface of third maxillipeds heavily clothed with hair.

Right chela (Fig. 5) long and narrow; palm thin, but somewhat inflated, fingers normal; palm and bases of fingers tuberculate; inner margin of palm heavily bearded. Both fingers terminating in short corneous tips, that of dactyl overhanging the other when the fingers are closed. Dactyl with about thirteen rounded tubercles proximally, the second and sixth from base largest and approximately equal to each other; opposable margin of immovable finger with eleven rounded tubercles at base, the fifth being the largest. Carpus (Fig. 5) tuberculate along inner margin; a single large spine at distal end beneath.

Hooks (Fig. 6) present on ischiopodites of third pereiopods only; length of hook equal to about two-thirds of the diameter of the ischiopodite.

First pleopods (Figs. 7–9) reaching to cephalic side of coxopodite of third pereiopods when abdomen is flexed. Apex terminating in four parts. Mesial process elongate, somewhat flattened on its transverse axis, extending slightly laterocaudad and distad beyond apices of other processes. Cephalic process subacute, a little less than half the length of the mesial process, extending slightly cephalomesad; a distinct angular hump present on cephalic margin at base of cephalic process. Caudal element consisting of a straight, elongate caudal knob capped distally by the corneous caudal process which is irregularly leaflike and excavate on its caudal face. Central projection corneous, saber-shaped and extending slightly caudomesad; fusion line of its two elements distinct.

Morphotype male, form II.—Similar to the

holotype in general appearance. First pair of pleopods (Figs. 10, 11) reaching to cephalic side of coxopodite of third pereiopods when abdomen is flexed; terminal processes non-corneous and reduced.

Allotype female.—Similar to holotype in general appearance. Annulus ventralis (Fig. 12) rounded; an anteroposterior trough-like depression extends from cephalic margin caudad to a centrally located pitlike depression; the sinus originates in this central pit and then runs posterosinistrad a short distance before making a sharp turn posterodextrad approximately to the midline where it turns posterosinistrad and extends nearly to the caudal margin. Cephalic half on either side of median trough raised and with a series of prominent irregular mammillary processes along border of trough.

Measurements.—As follows, in millimeters:

	Holotype	*Allotype*	*Morphotype*
Cephalothorax:			
Length	53.0	55.5	53.0
Width	26.0	29.0	27.5
Height	26.0	26.0	26.5
Areola:			
Length	18.0	19.0	18.0
Width (at narrowest part)	2.3	2.3	2.0
Rostrum:			
Length	12.0	12.0	12.0
Width at base	8.2	9.2	8.5
Abdomen:			
Length	51.0	54.5	52.5
Right chela:			
Length of outer margin of hand	49.0	40.0	48.0
Length of dactyl	30.0	25.0	30.0
Length of inner margin of palm	18.5	15.0	18.0
Width of palm	16.5	15.5	16.0

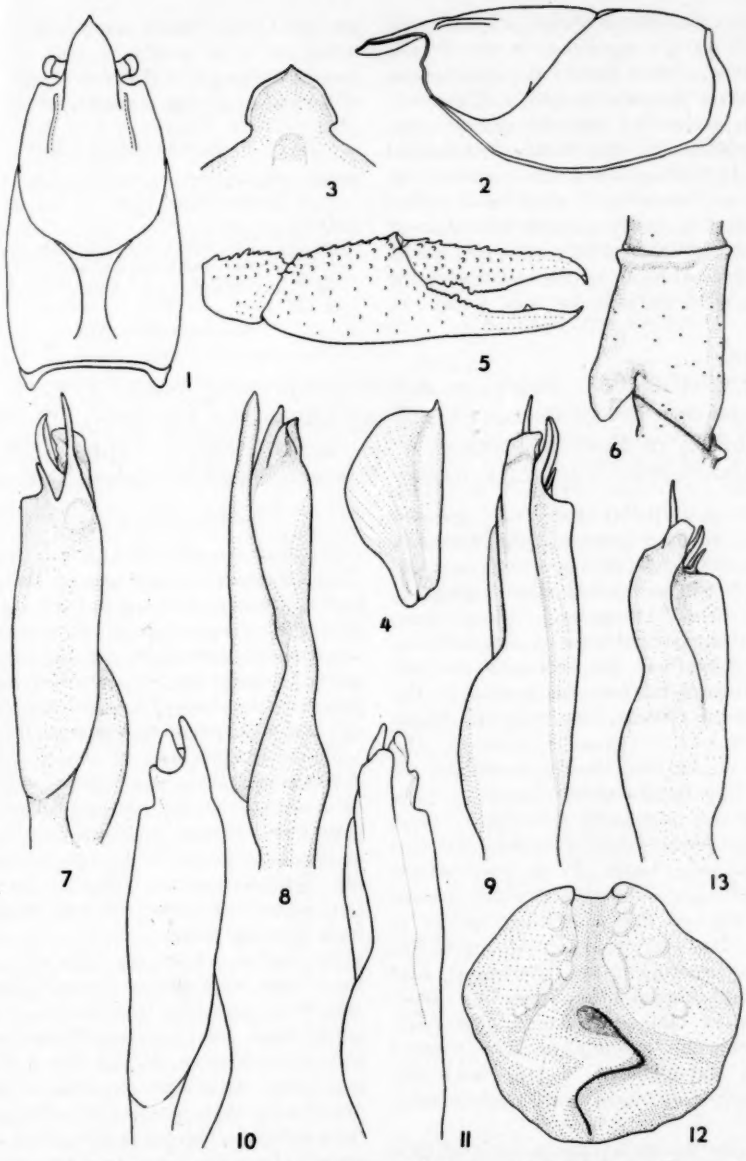
Type locality.—The holotype and allotype were collected from a small unnamed tributary of Bayou D'Arbonne, 4 miles west of Dubach (on Louisiana Highway 288), Lincoln Parish, La., on February 29, 1952, by Maj. Thomas H. Nickerson, U.S.A.F. Bayou D'Arbonne is a tributary of the Ouachita River, which combines with several other small rivers before emptying into the Red River. At the collecting site the creek is a narrow (3 feet wide), shallow, flowing stream; the holotype and allotype were dug from the same burrow, which extended about 2 feet straight into the blue-clay stream bank at a 45° angle before forking into two equal compartments, one crawfish in each terminus. No other species were collected at this locality.

The morphotype was collected from Big Creek at Fishville (3 miles east of Pollock on Louisiana Highway 19), Grant Parish, La., on February 22, 1938, by Percy Viosca, Jr. Big Creek is a tributary of Little River, which joins the same assemblage of streams into which the Ouachita River drains. At the collecting site Big Creek is a large, shallow stream with a sand bottom, sparse aquatic vegetation, and shaded banks. Other crawfishes collected at the same time were *Procambarus vioscai* Penn, *Procambarus blandingii acutus* (Girard), and *Orconectes palmeri creolanus* (Creaser).

Disposition of types.—The holotype, allotype, and morphotype are deposited in the United States National Museum, nos. 93655, 93656, and 79928, respectively. Of the paratypes series, one form II male, a female, and a juvenile female are in the National Museum; one form I male is in the collection of Dr. Horton H. Hobbs, Jr., at the University of Virginia; one form I male, one female, five juvenile males, and two juvenile females are in the Tulane University collection; and one form I male, two form II males, four females, and three juvenile males have been retained in his personal collection by Major Nickerson at Louisiana Polytechnic Institute.

Specimens examined.—Twenty-three paratypes of *Procambarus tulanei* in addition to the three types have been examined from Louisiana and Arkansas. These records and a summary of their deposition are as follows: LOUISIANA: Caldwell: Tributary of Ouachita River, 4.5 miles east of Columbia, August 2, 1948, L. L. Ellis (TU 430); Grant: Big Creek at Fishville, February 22, 1938, P. Viosca, Jr. (U.S.N.M. no. 79928); Jackson: Tributary of Dugdemona Bayou, 2 miles south of Clay, May 15, 1952, T. H. Nickerson (THN); Lincoln: Tributary of Bayou D'Arbonne, 0.25 miles north of Ruston, February 14, 1952, T. H. Nickerson (TU 2645); tributary of Bayou D'Arbonne, 4 miles west of Dubach, February 29, 1952, T. H. Nickerson (U.S.N.M, THN, TU 2648, 2831); Pugh's Pond, Ruston, April 1, 1952, T. H. Nickerson (THN); burrows in bank of tributary of Bayou D'Arbonne, Ruston, May 12, 1952, T. H. Nickerson (THN); burrows on L.P.I. campus, Ruston, May 18, 1952, T. H. Nickerson (THN). ARKANSAS: Columbia: [Tributary of Bayou Dorcheat], 7.8 miles south of Magnolia, April 9, 1952, E. A. Lachner et al. (U.S.N.M.).

Relationships.—In 1905 Ortmann placed *Procambarus simulans* in the *Digueti* section along



FIGS. 1–12.—*Procambarus tulanei*, n. sp.: 1, 2, Cephalothorax of holotype; 3, epistome of holotype; 4, antennal scale of holotype; 5, chela and carpus of holotype; 6, hook of holotype; 7–9, mesial, caudal, and lateral views of first pleopod of holotype; 10, 11, mesial and lateral views of first pleopod of morphotype; 12, annulus ventralis of allotype.

FIG. 13.—*Procambarus simulans* (Faxon): Lateral view of first pleopod of form I male from an impounded lake, 13 miles south of Channing, Oldham County Tex., July 1, 1952, F. R. Cagle et al. (TU 2795).

Pubescence removed from all structures illustrated.

with a heterogenous assemblage of species, and *P. gracilis* and *P. hagenianus* in the *Gracilis* section. Hobbs (1942) revised this classification and placed the three species mentioned above in a separate group (the *Simulans* group) of his newly established *Barbatus* Section. *Procambarus tulanei* clearly belongs to the *Simulans* group and is most closely related to *P. simulans*. *P. tulanei* and *P. simulans* closely resemble each other in most superficial characteristics. The two species can be separated easily by the structure of the first pleopod of the male (*cf.* Figs. 9 and 13), but not by the annuli ventrali of the females which are quite variable in both species. The geographic ranges of these two species meet in western Louisiana but apparently do not overlap.

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HELMINTHOLOGY.—*Studies on the helminth fauna of Alaska: XII, The experimental infection of Alaskan gulls* (Larus glaucescens *Naumann*) *with* Diphyllobothrium *sp.*

BERT B. BABERO, Arctic Health Research Center, U. S. Public Health Service, Anchorage, Alaska. (Communicated by Robert Rausch.)

For over a period of three years cestodes belonging to the genus *Diphyllobothrium* Cobbold (1858) have been routinely recovered from various Alaskan mammals, including man. The epidemiological nature of this helminthic infection is not yet completely understood. Experimental as well as field research has been undertaken by the Animal-borne Disease Branch of the Arctic Health Research Center relative to the possible control of diphyllobothriasis in Alaska. The results of the work to date, including the laboratory infection of dogs (*Canis familiaris*), foxes (*Vulpes fulva* and *Alopex lagopus*), bears (*Ursus americanus*), gulls (*Larus glaucescens*), and man, present strong evidence that only one species is involved. However, since its life cycle has not been experimentally determined, and since morphological study does not allow speciation of the adult worm, this must remain only an assumption. The present paper on the infection of gulls with *Diphyllobothrium* sp. constitutes a preliminary report.

The writer wishes to express his gratitude to Dr. Robert Rausch, chief of the Animal-borne Disease Branch, under whose supervision this work was carried out and who identified the cestode material, and to Miss Reggie Sacressen, whose aid in connection with this project contributed greatly to its success.

MATERIAL AND METHODS

For these experimental infections young gulls (*Larus glaucescens*) were secured from isolated nesting grounds on islands in Cook Inlet, about 20 miles southwest of the city of Anchorage. The numerous small island nesting sites were heavily grown to sedges and thus afforded ample protection for the young of hundreds of birds, among which several species were represented.

Thirty-six birds taken on June 21, 1951, were downy young; these were collected directly from their nests, or in the immediate vicinity. The nests were numerous and widely scattered and, in several instances, still contained unhatched eggs. The estimated ages of the birds taken ranged from 1 day to 2 weeks, and their weights were from 55 to 340 grams.

On July 15, 15 juvenile birds were collected from these same nesting grounds. The young gulls were located by flushing them from their grassy niches and by cutting off their retreat as they swam to shore. At this time it was noted that a few nests still contained eggs; examination of several of these revealed that they contained dead embryos. The young gulls taken were apparently from 1 to 6 weeks old and weighed 207 to 1,034 grams.

As a control 22 of the first group of 36 birds taken on June 21, and all those collected July 15, were examined post mortem, at the time of collection, to determine the extent of natural helminth infections. No parasites were recovered from the downy-young birds, and only one species

of a strigeid trematode was taken from the juveniles.

The 14 gulls intended for experimental use, after having been observed for about two weeks and having become accustomed to captivity, were color-banded, divided into five groups (see Table 1), and placed in five separate cages—designated A, B, C, D, and E.

During the course of the experiment, king salmon (*Oncorhynchus tshawytscha*), which had been quick-frozen and kept for over a year at a temperature range of −12° to −16° C., was used for feeding. At the time of collection it was noticed that the young birds were being fed exclusively on salmon brought to them from the beaches or from the refuse dumps of nearby canneries. Since there were no lakes nearby where infected fishes could be obtained, this seemed to preclude preinfection by *Diphyllobothrium* sp. The literature does not report, so far as the writer is aware, that this fish species harbors the plerocercoids of any species of *Diphyllobothrium*; consequently, the feeding of salmon by the gulls to their young would not seem to have any bearing on this experiment. The fact that our salmon had been stored for such a length of time at low temperatures made it highly improbable that larval cysts, if present, could still be viable.[1] During the first week of captivity, the young gulls were fed small pieces of salmon every three hours. The frequency of feeding was reduced with the age and the development of the birds.

Plerocercoids for the experiment (muscular and visceral in location) were recovered from rainbow trout, *Salmo gairdnerii* Richardson, taken from Daniels Lake on the Kenai Peninsula. The fishes of this lake had been previously studied by us and were known to be infected with *Diphyllobothrium* sp.[2] On July 7 viable plerocercoids were fed to the young gulls as follows: Each of the birds in cages A and B (see Table 1) received five visceral cysts and those in cages D and E received muscular cysts—three and four larvae each, respectively. The third bird of cage E (no. 14), after having seized some infected fish which was not intended for him, was rewarded with the entire fish; thus an unknown number of larvae was given in this case. On July 15 the experimental feeding of the birds in cages A and D was repeated, with each receiving the same number of larvae as before. At this time, both of the gulls in cage C were infected with five visceral cysts, making a total of 14 artificially infected birds. Autopsy of the young gulls was begun on the second day after the last infection and continued through the twenty-fourth day (see Table 1).

[1] Kjava (1913), as quoted in Magath and Essex (1931) stated that submitting infected fish to a temperature of −9° C. for 24 to 48 hours kills the larvae of *D. latum*; this was confirmed by the latter authors.

[2] This had been determined by morphological study of adult worms obtained through feeding plerocercoids to certain mammalian hosts.

RESULTS AND DISCUSSION

As may be noted from the table, seven gulls, or 50 percent, were found to be infected with *Diphyllobothrium* sp.; this included two of the eight birds that had received visceral cysts and five of the six that had received muscular cysts. It is probably incidental that those receiving muscular cysts showed a higher degree of infection. None of the birds in cage A was infected, despite their having received the most larvae. The small number of birds involved does not, however, permit any conclusions. Segment counts of three 13-day-old strobilae gave an average of 333. This figure may serve to indicate the rapid rate

TABLE 1—EXPERIMENTAL INFECTION OF GULLS WITH DIPHYLLOBOTHRIUM SP.[1]

Host No.	Date of infection		Number of larvae administered	Larval type		Days elapsing before autopsy	Number of worms recovered
	July 7	July 15		Muscle	Visceral		
Cage A							
1	X	X	10		X	2	0
2	X	X	10		X	6	0
3	X	X	10		X	24	0
Cage B							
4	X		5		X	2	0
5	X		5		X	6	0
6	X		5		X	13	0
Cage C							
7		X	5		X	7	2
8		X	5		X	12	4
Cage D							
9	X	X	6	X		2	3
10	X	X	6	X		6	3
11	X	X	6	X		24	1
Cage E							
12	X		8	X		2	6
13	X		8	X		6	0
14	X		?	X	X	13	37

[1] Thirty-seven controls, negative for helminth parasites, are not included in table.

of growth. All worms recovered were fixed, stained, and mounted for morphological study.

Macroscopic examination of the specimens of *Diphyllobothrium* sp. recovered from artificially infected gulls, as well as those from dogs, foxes, bears, and man, reveals a great range of variation in gross appearance. Possibly the host species involved, its physiological condition, and the age of the worm may be the primary determining factors in the morphological variation of the adult form. Stunkard (1949) pointed out that "species now included in the genus constitute a heterogeneous collection, from a variety of hosts and bionomic areas, but the morphological diversity is so distributed among the species and so many different combinations of characters exist that the arrangement of the species into related groups must await further information." Rausch (1951) stated, "Speciation on the basis of morphological characters of tapeworms of the genus *Diphyllobothrium* is impossible for the Alaskan forms." These statements indicate that a new approach, rather than a taxonomic one, must be made to the problem of speciation of the worms of this genus.

The successful infection of gulls with *Diphyllobothrium* sp. considerably complicates the problem of control of this helminth in Alaska. Bent (1921), in connection with the glaucous-winged gull, wrote, "This is the most abundant, the most widely distributed, and characteristic gull of the north Pacific coast . . ." The vast numbers of these birds, coupled with their potential for disseminating viable eggs over a wide area will undoubtedly enhance the chances of survival of this parasite in Alaska. Terrestrial mammals which utilize fishes for food also constitute an important reservoir of infection, but nevertheless this is one which probably could be controlled locally if diphyllobothriasis were ever thought important enough to human health to justify extreme measures.

The low living standard of the Alaskan native often compels him to depend on fish almost exclusively or at least as a substantial part of his diet. Local customs and the conditions under which many of these people live necessitate the eating of raw or poorly cooked fish. Preliminary surveys made to date reveal that the percentage-incidence of infection among the natives in certain areas where *Diphyllobothrium* sp. is endemic is quite high. Hitchcock[3] (1950; 1951), during her parasitological investigations of the Bethel and Kotzebue areas, found an incidence of infection of 15 and 6 percent, respectively. Although the pathogenicity of *Diphyllobothrium* is not well understood, it seems probable that the disease may aggravate, in areas where it is endemic, the present serious health condition of Alaskan natives. Consequently, diphyllobothriasis must be regarded as a definite public health problem in Alaska.

A more intensified investigation of the immunological characteristics of this parasite in native birds and mammals in Alaska will be undertaken during the field season of 1952.

SUMMARY

The experimental infection of glaucous-winged gulls (*Larus glaucescens*) with *Diphyllobothrium* sp. has been accomplished. All available evidence indicates that this Alaskan species readily infects gulls, various wild carnivorous mammals, and man. The specific identity of this cestode has not been determined.

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[3] Miss Hitchcock was employed as a consultant for the Arctic Health Research Center at the time these surveys were made.